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INDIVIDUALITY AND SCIENCE[1]

By Dr. ALBERT FRANCIS BLAKESLEE

COLD SPRING HARBOR, N. Y.

THE presidency of the American Association for the Advancement of Science is both an honor and a punishment. The first year the president has merely to preside and look intelligent, or as intelligent as possible, at a plenary session of the association. The second year he has the punishment of a Binet test in a formal address before a formidable audience of his peers and peeresses.

Some of the former presidential addresses of the association have given a review of the research activities of the speaker; some have discussed the broader aspects of science. I shall attempt to combine these two methods and after briefly discussing some investigations in which I have had a share, shall say something of the relations which science may have to human welfare.

In looking over my past research activities, the one idea which impresses me most is the individual diversity among the living organisms which I have used as objects of study. Our first published investigations had to do with a group of lower fungi which can be included in the name of Bread Molds. Among these we discovered that growths which looked alike might differ in sex and in a wide range of chemical responses.

Another example of cryptic chemical differences

[1] Address of the retiring president of the American Association for the Advancement of Science, Dallas, Texas, December 29, 1941.

was furnished by the black-eyed Susan (*Rudbeckia hirta*). Two races which had yellow instead of purple cones we found could be distinguished by use of strong potash solutions. The treatment turned the cones of one race black and those of the other red.

These examples have to do with innate differences between individuals. Let us consider some examples of differences in which the environment appears to be the controlling factor. One variety of corn has red kernels at the ends of the ears where they are exposed to the sun but white kernels where they are covered. Both the red and the white kernels when planted, however, gave the same kind of offspring. What was inherited was the capacity to become red in a light environment and white in a dark environment. Another example of the interaction between the innate constitution and an environmental factor is furnished by the pink hydrangea. My wife happens to prefer them blue. It was a simple matter to satisfy her color preference by feeding them iron. There is no reason to believe that the change in flower color from pink to blue had any effect upon the innate nature of the plant.

I used to ask my students to find two apple leaves which were alike. They would start in with enthusiasm, but soon would come to realize that two leaves exactly alike could not be found if one used as a simple criterion of identity the possibility of having the two leaves match with all their indentations when one was superimposed upon the other. I would point out that the general pattern of the apple leaf in distinction from that of an oak, for example, was due primarily to its hereditary constitution but that the wide variations in size and shape of leaves and the arrangement of teeth on their edges were modifications of the pattern induced by differences in the environment such as the position of the developing leaf in relation to light and shade, vigor of the twig, its position in the developing bud and other possible factors in internal environment. The original Baldwin apple tree has been extensively multiplied by grafting. It remains the same tree with the same hereditary constitution but has produced an enormous number of leaves. It is safe to say that no two of these leaves have ever been exactly alike if in addition to external features we take into consideration also the finer structures such as number, form and arrangement of their cells.

With these considerations in mind it is not difficult to realize that probably no two trees in orchard or forest can ever be exactly alike, since in addition to the modifications brought about by variations in environment we have the modifications brought about by differences in hereditary constitution.

In the jimson-weed, the plant with which I am most familiar, many striking examples could be given of the interaction of environment and heredity. Often the effects of each are similar.

We are interested in a recent hereditary mutation which has similar effects on the plant to those brought about by the environmental influence of a virus which we had earlier called *quercina*. Both the quercina virus and the quercina gene cause the elimination of spines from the capsules, the elongation of the stigmatic surface on the pistil, the erosion of leaf margins and the change from a tubular corolla to one with separate petals. The quercina condition has special interest from the view-point of the possible similarity in nature or mode of action between virus particles and genes. It is mentioned here, however, as another example of the fact that both environment and hereditary factors as primary causes may bring about similar effects.

Although we can influence the character of organisms through the environment, it is generally believed that we have no control over their heredity. This is not entirely true.

Records this month on seedlings of jimson-weed which had grown from seeds buried for 39 years in soil at the U. S. Department of Agriculture in Arlington seem to be showing an increased rate of mutations. We can not predict the exact types of hereditary changes that will be induced by aging and other stimuli. In some cases in the jimson-weed, however, we have used mutated chromosomes with which to synthesize new pure-breeding types with predicted characteristics. By attention to the total number of their chromosomes we have reduced their ability to hybridize with their parental types and hence feel justified in calling them synthesized new species.

By one method we have succeeded in exercising conscious control over heredity and are able to predict with reasonable accuracy the characteristics of the new types induced through doubling their chromosome number by means of colchicine. In our own and other laboratories new species have been produced by doubling the chromosome number of sterile species hybrids, and new species are known to have been produced by this method in nature.

I shall give one illustration from animals. In white Leghorn poultry, yellow pigment may be present in the earlobes and legs. When a bird is laying heavily the yellow disappears. Several years ago we showed a close connection between the amount of yellow pigment and a bird's past laying record. This color test has become a practical method of selecting good layers for breeders. Heavy laying is not the only environmental factor which will decrease the amount of yellow. Lack of green food and sickness have similar effects. Hereditary factors also have an influence upon the pigmentation, since in the English Orpington

breed, for example, yellow is absent from the body fat. Here again heredity and environment induce similar end results.

In many biological problems affecting human beings, science has had to look to botanists to lead the way. I need to remind you only of the original discovery of the mechanism of heredity by Mendel from his work on garden peas and its later independent rediscovery by three botanists. My interest in human individuality came from my experience with plants. It all started from a botanical problem in 1917 when we were trying to classify the colors of a segregating pedigree of Verbenas. A particular pink-flowered form was very fragrant to me but had absolutely no odor to my assistant. On the other hand, a certain red-flowered Verbena was fragrant to him but not to me. Some of the people in our laboratories agreed with me and some with my assistant. Only a very few found fragrance in both kinds of flowers.

Phenyl-thio-carbamide, which may be abbreviated to P.T.C., is a good reagent with which to show innate differences between people. Some of those we have tested need to have the solutions of P.T.C. more than 8,000 times as strong as others in order to taste it. The inability to taste the commercial crystals is inherited like blue eyes as a Mendelian recessive character, but different grades of taste acuteness have also been shown to be inherited. Numerous tests with other substances only emphasize the wide differences between people in their taste reactions. Some may remember the taste tests at the Richmond meeting when members of the association were asked to vote as to what the real taste of mannose is. They could not agree. Some voted tasteless, some bitter, some sweet and some voted sour or salt or some combinations of these tastes.

There are some interesting after-tastes. Over half the people after eating globe artichokes find the water tastes sweet, and tobacco smoke tastes sweet to some but not to all after the mouth has been rinsed with a solution of copper sulfate.

To the majority of people there are four primary tastes: sweet, sour, bitter and salt. A considerable number, however, we have found can not distinguish bitter from sour. To them quinine and vinegar taste alike. When these substances are weak they may be called sour and when they are strong bitter, but the taste is the same except for strength.

The individual reactions of taste are dependent primarily upon innate hereditary factors and the environment appears of relatively little importance. With smell the condition is quite the opposite. Probably even wider innate differences exist between people in their acuteness of smell than of taste, but environmental factors in abundance prevent the full expression of these hereditary differences. Thus age is a potent factor progressively dulling the sense of smell. A considerable number of people have lost their sense of smell entirely. Temporary conditions of a person, such as a cold in the head, may adversely affect his ability to smell. After being exposed to an odor for a time it becomes no longer perceptible. Olfactory fatigue apparently may be produced even by concentrations too weak to be detected. This is probably the explanation of asphyxiation of people by gradually increasing concentrations of gas which they never detected.

The sense of smell does not play as important a role in man as in many of the lower animals in bringing us information about the external world. There are not a negligible number of people, however, who can distinguish different individuals by odor in the same way in which dogs can distinguish individuals by scent alone. This power is more frequent in children but is often retained into adult life when it is generally concealed on account of the social taboo against speaking of personal odors. Several parents have informed me that certain of their children when young by smelling a handkerchief they had picked up could tell to which member of the family it belonged, but this ability had been lost after they had grown up.

It is possible to learn something about the emotional response to sensory reactions. At a talk given a year ago before the Lancaster branch of the American Association for the Advancement of Science one half of the audience was supplied with powdered kaolin with a weak concentration of cuminol (0.33 per cent.) and the rest of the audience had kaolin in which the concentration was ten times as strong. Reactions of each person who could detect the odor were recorded as to whether it was pleasant, indifferent or unpleasant. When the odor was weak more found it pleasant than unpleasant, but when the odor was strong the reactions were reversed and more found it unpleasant than pleasant. (See Table 1.) This test, as well as other observations, demonstrates that strong odors

TABLE 1

TESTS OF CUMINOL POWDERS*
LANCASTER, PA., JANUARY 30, 1941
Cuminol dilute (0.33 per cent. in Kaolin)

Odor	Absent	Pleasant	Indifferent	Unpleasant	Total number
Males	6.03	31.90	47.41	14.66	116
Females ...	6.36	21.82	50.91	20.91	110
Totals	14	61	111	40	226
Per cent.	6.19	26.99	49.12	17.70	
Cuminol concentrated (3.3 per cent. in Kaolin)					
Males	2.92	24.09	35.77	37.23	137
Females ...	2.94	9.80	28.43	58.82	102
Totals	7	43	78	111	239
Per cent.	2.93	17.99	32.64	46.44	

* Individual reactions to odors are given in percentages.

tend to be disliked. It should not be forgotten, however, that what is weak to one may be strong to another because of innate differences and also because of environmental factors.

Of greatest influence upon our likes or dislikes for a given odor appear to be the pleasurable or unpleasurable associations which have been built up around it. We apparently ourselves once assisted in the development of an unpleasant association. In an early test of cuminol we had made the concentration much too strong, and the majority of the subjects disliked it. A few days later we tested the same persons with a very weak concentration. Several said, "Oh, that's the same as the awful smell you gave us before" and immediately called it unpleasant. Apparently some at least of these subjects had established an unpleasant association with the odor of cuminol when it was presented to them in strong concentration but would have considered it pleasant, or at least indifferent, if they had smelled it for the first time in a weak concentration. The likes and dislikes expressed for weak concentrations of cuminol may be due to associations with objects which are believed to give off similar odors. A wide variety of answers have been given to the question: What does cuminol smell like? They range from roses and citrus rind on the pleasurable side through caraway seeds to bedbugs and perspiration. The fact that one does not himself consider unpleasant those odors which are purely personal is an argument for the contention that there is no odor, aside from its strength and associations, which is intrinsically either pleasant or unpleasant.

Associations are especially powerful with the sense of smell, but they exist with all the senses. So long as we live we are building up associations and developing our personality through reactions with our environment which express themselves in likes and dislikes. Likes and dislikes are important determiners of our behavior.

The examples just given of the influence of heredity and environment have been taken from the senses of taste and smell. All the other senses are similarly subject to internal and external influence. I need only mention the innate differences in musical discrimination disclosed by Seashore and the progressive decrease, under the environmental influence of age, in the pitch or number of sound vibrations one can distinguish at a given intensity. There are a host of other responses which contribute to human individuality. Among these are the blood groups, the natural and acquired susceptibilities and immunities to disease and chemical substances, the allergies and the reactions to hormones and vitamins. The Binet and other mental tests have disclosed great differences between individuals in mental equipment.

It will be granted no doubt that there are great differences between people in their sensory judgments regarding the world in which they live and that these differences are influenced in varying degree by factors of both heredity and environment. Is this true of man's mental and spiritual judgments? I believe it is even more so. A few simple examples may be given.

At the end of the Lancaster meeting already referred to, the audience was asked to select the best title among five which had been suggested for the lecture just given. It might be thought that since all had

TABLE 2

VOTES FOR TITLES IN RELATION TO POSITION ON BALLOT
LANCASTER, PA., JANUARY 30, 1941

	Titles	Position on Ballot* 1st	2nd	3rd	4th	5th	Total votes	Per cent. of total	Rank
Males	Why people differ	2.08 A	5.26 E	5.26 D	7.69 C	9.26 B	15	6.02	4
	Differences between people in taste and smell	44.44 B	70.83 A	63.16 E	59.65 D	69.23 C	152	61.04	1
	What makes differences in personality	1.92 C	14.81 B	6.25 A	5.26 E	8.77 D	19	7.63	3
	Demonstrations of heredity and environment	3.51 D	3.85 C	11.11 B	4.17 A	2.63 E	13	5.22	5
	Why each person lives in a different world	23.68 E	22.81 D	17.31 C	20.37 B	16.67 A	50	20.08	2
	Total number	37	59	45	53	55	249	99.99	
	Per cent.	14.86	23.69	18.07	21.29	22.09	100.00		
Females	Why people differ	8.70 A	2.17 E	10.53 D	9.30 C	8.57 B	16	7.69	3
	Differences between people in taste and smell	62.86 B	47.83 A	65.22 E	57.89 D	60.47 C	122	58.65	1
	What makes differences in personality	4.65 C	.... B	10.87 A	4.35 E	7.89 D	12	5.77	4
	Demonstrations of heredity and environment	5.26 D	 C	5.71 B	6.52 A	10.87 E	12	5.77	4
	Why each person lives in a different world	17.39 E	18.42 D	25.58 C	22.86 B	26.09 A	46	22.12	2
	Total number	38	30	52	39	49	208	100.00	
	Per cent.	18.27	14.42	25.00	18.75	23.56	100.00		

* Five titles were listed in different orders on five ballots A to E.
Numbers under each position are percentages of votes cast for given title on the ballot indicated by letter at right of figure.
Males: Ballot A was voted 48 times; B, 54 times; C, 52 times; D, 57 times; E, 38 times.
Females: Ballot A was voted 46 times; B, 35 times; C, 43 times; D, 38 times; E, 46 times.

heard the same lecture, there would have been considerable unanimity in preference. This was not the case, however. Though two titles had more votes than the others, each of the five titles was preferred by a considerable number. Here again we may be reasonably sure that factors of both heredity and environment did influence the mental judgments regarding the best title.

Unbeknown to the audience, the titles were in different orders on five different kinds of ballots which were shuffled before distribution. The records clearly show that there was no advantage so far as number of votes secured was concerned in having a title come first on the ballot. (For records see Table 2.)

A similar experiment with the same set of shuffled titles was earlier tried after a talk on taste and smell before an audience of 270 students at the Farmingdale Institute of Applied Agriculture on Long Island. Perhaps because the lecture, as well as the audience, was somewhat different, the percentages of votes cast for the various titles was considerably different from those in Lancaster. The position on the ballot, however, again did not seem to have any material effect on the voting. A different psychology might conceivably be involved in voting on questions in a referendum from that in voting for candidates in an election.

With the expectation of being able to show that position of candidates on a ballot would have no influence with a group of intelligent voters I next tried an experiment with scientists.

Under the authorization of the Executive Committee of the Association, a study is being made, in cooperation with Dr. Sewall Wright, of the effect of position of candidates' names on this year's preferential ballot for president of our association. There were four types of ballots sent out from the Washington office after they were properly shuffled. In one the names were arranged alphabetically; in the others the names were arranged at random, except for the first and last places for which names were selected on account of their high standing in last year's balloting.

We hope to publish a statistical analysis of the data at an early date. In the meantime, however, it will suffice to present some provisional conclusions from our arithmetical tabulation of the ballots received up to November 28th. (See Table 3.)

In all cases the percentage of votes for a candidate on the ballot in which his name came first or second was in excess of the average percentage he received on the other ballots. Other positions appear to have had little effect on the voting. If we use the excess in votes for a candidate in first or second place over his average in other positions as an index of the number of people who would not have voted for him if he had had a less desirable place on the ballot, then the percentage of votes due to preferred position on a given ballot range from 14.3 to 45.7 per cent. This would mean that between 3 and 4 per cent. or over 150 of the 4,000 members of the association who voted may have been influenced by the order of names on the ballot. (A biometrically more reliable measure of position effect on the ballots we hope to discuss in our joint paper, but it seems justifiable to use the suggested

TABLE 3

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
TABULATION OF BALLOTS FOR PRESIDENT, NOVEMBER 28, 1941
SELECTED NAMES TO SHOW POSITION EFFECT
F = Name *first* on ballot. S = Name *second* on ballot. L = Name *last* on ballot.

Nominee	Ballot 1	Ballot 2	Ballot 3	Ballot 4	Totals	Average excluding F or S	Estimated per cent. due to position
A	200 F	147	158 L	143	648		
Per cent. ..	18.85	14.73	15.94	14.80	16.14	15.16	19.58
F	38	59 F	40	36	173		
Per cent. ..	3.58	5.91	4.04	3.73	4.31	3.78	36.04
V	29 L	30	57 F	35	151		
Per cent. ..	2.73	3.01	5.75	3.62	3.76	3.12	45.74
Q	89	81 L	83	94 F	347		
Per cent. ..	8.39	8.12	8.38	9.73	8.64	8.30	14.70
B	91 S	65	73	79	308		
Per cent. ..	8.58	6.51	7.37	8.18	7.67	7.35	14.34
N	57	60 S	43	47	207		
Per cent. ..	5.37	6.01	4.34	4.87	5.15	4.86	19.13
L	58	73	72 S	50	253		
Per cent. ..	5.47	7.31	7.27	5.18	6.30	5.99	17.61
G	39	36	35	53 S	163		
Per cent. ..	3.68	3.61	3.53	5.49	4.06	3.61	34.24
O	30	35	31	31	127		
Per cent. ..	2.83	3.51	3.13	3.21	3.16		
Totals	1061	998	991	966	4016		
Per cent. ..	26.42	24.85	24.68	24.05	100.00		

provisional measure to point the trend of influence of position.)

To show that the position on ballot may possibly be of practical importance, we may compare the votes for two candidates who belong to the same section of the association and who would be generally considered rather closely comparable in age and in experience and eminence in both research and administration. The man whose name came first on one of the ballots stood two ranks ahead of the other candidate in total votes received. When, however, our correction was applied for his preferred position on the single ballot, he ranked one grade below the other candidate.

The fact that every one of the 22 candidates received a considerable number of votes is itself an indication of wide diversity in judgments of the voters. This may be attributed to differences in the fields of science represented and in the familiarity with the work of the various candidates. The balance between these environmental influences undoubtedly has a hereditary basis. That so many scientists should be influenced by such a trivial environmental difference as whether a candidate's name comes in the first two places or later in the ballot was unexpected. Those so influenced perhaps had a hereditary constitution different from the other voters. The results of the balloting of the American Association for the Advancement of Science show at least that we are not a class apart, uninfluenced by hereditary and environmental factors which sway the judgments of other people.

The Supreme Court of the United States is composed of outstanding minds. Their honesty is unquestioned and they are freed from even the unconscious pressure of political expediency. Here, if anywhere, we should expect unanimity. The Supreme Court, however, from its early history has rendered numerous decisions by a divided vote and in many instances, including some of the most important cases, by a majority of only one. With its broadly changed complexion since early New Deal days, one might expect less diversity in judgment at the present time. This does not seem to be the case judging from a last month's news report of the first two decision days of the present term. Within two weeks there were brought in three 5-to-4 and two 6-to-3 decisions. None of the justices during this time had failed to enter at least one dissent and all except two had more. We can not here attempt to analyze the elements in these differences in judgments. Such blanket terms as liberal and conservative suggest the influence of innate disposition and also of such environmental factors as advancing age. If we remember our experiments with taste and smell we may agree that judgments of drinkers regarding the taste of beer and judgments of the Supreme Court regarding issues of law can not help differing because men both are born different and have differences thrust upon them by their environment.

Differences in expression in art, music and literature can likewise be attributed to influences of heredity and environment. I have personally been interested in studying the manner in which trees have been used in art. Styles in method of representation are evident, but the artists differ in the way in which trees appeal to them. Some are interested in individual trees, others in groups. Some prefer trees in the foreground, others in the background or in the middle distance. There are differences also in the species of trees which different artists like best.

We have given examples of differences in plants and animals such that no two individuals are exactly alike and have classified the causes of these differences into the interacting factors of heredity and environment. We have shown that both heredity and environment are likewise responsible for the diversities in man, not only in his physical structure and sensory reactions but also in his mental and moral judgments. Every thought and act of our lives is influenced by these two factors. Man has used his knowledge of heredity and environment to mold plants and animals to his personal advantage. Can this be done with man himself? To some extent, yes, but the way is not so clear.

I know of no adequate evidence that man to-day is a better animal physically or mentally than at the dawn of history. While man's biological evolution during these five thousand years and more has seemed to lag, and at the present time has appeared to many to have been thrown into reverse, man's environment has changed markedly even within our own lives. Conscious control of human heredity, though a desired goal, will at best be slow even if our genetic knowledge were adequate for the task. Changing man's environment gives promise of more rapid betterment of human individuals, and in this effort we are far from reaching diminishing returns.

But the facts of individuality and the relative influence of heredity and environment upon personality must be carefully estimated in any rational campaign for permanent social betterment. Such knowledge has power to revolutionize our ideals and practice in social and religious justice, charity and education, methods of legislation and forms of government. Methods of education, for example, have been severely criticized for mass regulations which fail to take adequate account of individual excellences. Pedagogy has been called a racket, a pressure group which has forced legislation more in the interest of the pedagogical profession than in the interest of the individual

students. Schools of education are accused of padding their curriculum in an attempt to compete in standing with other disciplines, and doctorates in education are considered inferior to those in other departments. This is strong language and may not be justified, but we have heard it repeatedly. Some of the criticisms are undoubtedly due to the difficulties inherent in the study of any subject in which variables are many and difficult to control. Similar criticisms come from the so-called exact sciences, mathematics, physics and chemistry, against the difficult, less exact biological sciences, botany and zoology, and some would even deny the name of science to those most difficult studies of man's social behavior. For years the educational world has been struggling with the problem of how best to deal with the increasingly recognized differences in mental ability, differences which, like those we have found in taste reactions, are of two kinds: a difference between general marked ability and general mediocrity and a difference between ability in certain lines such as mathematics, science, art or literature.

I recently wrote to the sixteen living past presidents of our association and asked them if they could satisfy the enclosed New York State requirements for teaching in the state secondary schools. Not one of the past presidents of the American Association for the Advancement of Science would be allowed to teach science in a New York high school without further preparation since none had taken the required instruction which included such subjects as the psychology, history, philosophy, principles and practice of education. One past president properly remarked that not all presidents would have been good secondary school teachers. It is a fact, however, that more than a quarter have had secondary school teaching experience, but could not now qualify under present requirements. This is not at the present time a serious deprivation of the freedom of these men, but some believe the state methods of selecting teachers place undue emphasis upon relatively unimportant requirements. Some educators have told us that in the balance between method and subject-matter they believed the pendulum had swung too far toward method.

Blanket regulations may make for ease of administration, but too great uniformity may preclude the assets of individuality. Uniform laws throughout the states would have certain advantages, but they might not be equally well adjusted to local environments and might prevent profitable experiments in local government. The increased means of communication throughout the world appear a mixed blessing. They tend to standardize our thoughts and behavior in a common mold but at the same time to decrease the material expressions of individuality available for social evolution through natural selection.

In the Imperial Valley of California some years ago the cantaloupe industry was on the point of ruin because of a fungus disease for which no adequate remedy was known. The problem was solved by bringing a gene for disease resistance into the stock through hybridization with an inferior race from India. If only one variety had been grown throughout the world we would probably not now have the pleasure of eating cantaloupe for breakfast. Thus the cultivation of a single variety which is a high yielder may be of immediate advantage, but if grown exclusively it may cause the irreplaceable loss of genes of great value which are now combined in less desirable varieties.

Opposition to totalitarianism is not merely because it attacks man's rights but also because it suppresses his personality. Individuality is the kernel of democracy, the biological basis of the struggle for freedom. When we fight for individuality we fight on the side of nature. Recognition of individuality and all that it implies especially concerns us as scientists. Even if science were again persecuted and driven under cover, as it was in the middle ages, there would still be some brave inquiring minds. But science can not flourish without freedom of thought and its expression.

Why do I emphasize the value of individuality to science? Because I believe science is the great hope of mankind.

In speaking of science and scientists it should be clear I am not confining attention to the professionals. Whoever by observation or experimentation is responsible for increased knowledge of the world in which we live is a servant of science and contributes to the welfare of mankind. In this connection it is appropriate to mention that in colonial times keen observers had discovered the causal connection between barberry bushes and infestations of wheat rust and had passed laws in Massachusetts for the eradication of barberries long before botanists learned that a necessary stage in the life cycle of this rust is confined to the barberry.

Science is under fire for the suffering brought about by its applications, especially in the present war. Science is in no position to disavow its responsibilities in the problems of peace and war. As in epidemics of disease due to the ignorance of medicine we need not less but more medical knowledge, so in seeking a cure for the scourge of war we need not less but more science. The remedy we trust may ultimately be found by that most difficult of all biological sciences—the study of motives and human behavior. Science can reply to its critics that the applications of science are merely tools which men with good or bad motives use for their good or evil ends. The same can be said of printing. Even if we admit the responsibility of

science for deaths due to its applications we will find that its applications have brought about even greater savings of life. The legend to a reproduction of the title page of Jenner's paper on vaccination published in 1798 reads: "The application of the facts presented in this paper has probably saved more lives than the total of all lives lost in war." The statement is easy to believe, since it has been estimated by Haggard that in the 100 years preceding Jenner's paper, sixty million people in Europe died of smallpox.

In war itself science has not been alone destructive, as may be seen from figures supplied by the Surgeon General's office regarding the annual death rate per thousand in the United States Army for the Mexican War, the Civil War and the first World War. Deaths due to battle injuries increased from 15 per thousand for the Mexican War through 33 for the Civil War to 53 for the World War. The death rate due to disease, however, decreased from 110 through 65 to 19 for the World War. The net result is that the total death rate actually declined, from 125 in the Mexican War through 98 in the Civil War to 72 per thousand in the World War. It is a satisfaction to feel that though implements of war have increased in destructiveness, those who are fighting to preserve our free way of life may not be subjected to greater risks than our forefathers assumed when they too fought for their country.

It can hardly be emphasized too strongly that it is not man's material comforts nor even the alleviation of his physical pains which are the greatest gifts of science to mankind. Science has freed men's minds. Foremost among liberating ideas is the belief that there is order and law in the universe and that this order can be discovered by questioning nature herself. Such belief was rare in the middle ages when processes of nature were generally attributed to supernatural causes: winds and storms to demons, comets and epidemics to the wrath of the Almighty toward a sinful world, and investigations of nature were persecuted by both church and state as Satanic magic and sacrilegious questioning of the acts of God. The Copernican theory widened our physical horizons and showed our earth a tiny speck in a universe of worlds. The theory of evolution brought a unity to our ideas of the organic world. The discovery of the mechanism of inheritance allowed an evaluation of the contributions of heredity and environment to the personality of individuals. The experimental method with adequate controls is the most valuable tool science has yet developed. Its understanding and use in daily life would mean more than all the scientific facts that schools can teach.

Science has helped to free man's soul. It has broadened the horizons of religion and given it a new point of view away from the old intolerant, materialistic theology when men sought their own salvation from selfish hope of heaven or fear of hell and persecuted or even killed those who did not conform to the authority of orthodox beliefs. Elimination of such incumbrances has left to religion a freer field for the cultivation of its great spiritual values. In this shrunken world all mankind are neighbors and our benefactions have had a world-wide view.

Science has banished much of ignorance and superstition, but much remains. Recently in New York's Pennsylvania Station I purchased seven different magazines on astrology. One of them, and this not the best seller according to my newsdealer, I found had a monthly paid circulation of over 132,000 copies. (The circulation of our journal SCIENCE is about 15,000.) The readers of these astrological journals are part of our democracy and help to form the policies of our government. Other examples need not be given to show that the scientific method has not yet saturated our land.

If we consider past efforts to better mankind, it is clear that good intentions are untrustworthy criteria of service to humanity. The biblical criterion "By their fruits ye shall know them"—is biologically sound doctrine and still the best test. The attempts to suppress independent thought and study of nature in the middle ages, and up to the not distant past in our own country, were inspired by noble motives, but they put civilization back by many centuries. The crusaders had a lofty purpose but a trivial objective:—the capture of an empty tomb, with all too slight appreciation of the teachings of Him whom the tomb had held. The net result was unnecessary suffering and death even among a group of children who became involved.

Love of our neighbor is one of the loftiest ideals of the Christian faith. Sympathy and kindness toward those in need we can never do without—for our own sakes as well as for those who are helped. But charity covers a multitude of misplaced aims. It may attack symptoms merely rather than the cause of the ills to which it ministers and thus delay their cure.

During the plague of the seventeenth century when 25 million people or a quarter of the population of Europe died of this dread disease, there were doubtless, as there should have been, hospitals and other organized efforts to minister to the sick and dying. We can imagine the scant attention that would have been then paid a request for a grant for a scientific study of the life habits of such creatures as rats, fleas and the wriggling animalcules which Leeuwenhoek discovered at about this time in drops of putrid water. And yet our knowledge of rats, fleas and bacteria is one reason why centuries later pest hospitals are not found in London and we no longer dread the plague.

The illustration given is an example of the unsuspected value of knowledge in apparently unrelated fields. Many other examples could be given of the service of science to human welfare, a service which is often indirect. The ancients used human sacrifices to ensure bountiful harvests. Now we use commercial fertilizers for this purpose and find them more efficient. In the old days people fought yellow fever and smallpox by church rites and religious processions. Now we fight these diseases by killing mosquitoes and by vaccination. Formerly thousands of people were executed on the ground that they were witches. Science has proved that witchcraft does not exist. It would be difficult to give from history as striking examples of success in direct efforts to improve the condition of mankind without the aid of science.

Knowledge is power also in our efforts toward human betterment. We must learn the facts about the environment in which we live if we wish to adjust ourself into harmony with it. Efforts against nature are doomed to failure despite high motives. It is for this reason we believe that in a rational program for human betterment science—the free search for truth—is in the long run the best investment. If what I have said is true, it lays upon us all, both scientist and layman, a responsibility for the advancement of science, free and unhindered as a service to mankind. Think where we would have been now if in the dark ages men like Copernicus, Galileo, Albertus Magnus, Roger and Francis Bacon among other inquiring minds had been able to carry on their scientific investigations in an atmosphere of intellectual freedom. Our most difficult sciences might now have reached the stage occupied by biology, for example, and we might already have found a remedy for our present sick civilization.

How can science best be fostered? I need offer only a few suggestions.

Science in common with all intellectual pursuits needs tolerance, freedom from restraint and a recognition of the value of individuality. Men differ widely in their capacities for research. A great need therefore in the advancement of science, as of other intellectual endeavors, is to devise means for discovering the exceptional abilities at an early age and giving such abilities exceptional opportunities in order that their span of effective service with its social values may be prolonged.

The public, whom science serves, knows all too little what science really means. The magic and gadgetry of scientific applications rather than the methods and ideals of science make the great appeal. And yet the ideals and methods would help society reach judgments on the basis of ascertained facts rather than through emotional appeal and personal profit and would transform our daily lives if universally applied. Think what a change would come if our representatives in legislative halls should open each session with the prayer of Huxley: "God give me strength to face a fact though it slay me"—and really mean it.

A common comment of a layman after visiting a laboratory and having research explained to him is "what great patience scientists must have." The real thought appears to be how can reasonably intelligent men, as scientists seem to be, be content to spend time in such trivial and uninteresting details. The layman seems to feel as he might in watching a small child picking up little white pebbles laboriously one by one and putting them into a bucket and then taking them out again one by one in the same painstaking manner. And yet this same layman sees reason in taking a stick and whacking a diminutive white ball over a field, alone or in company with others, and each time he gets it into a little sunken bucket he takes it out again and whacks it to another bucket of the same dimensions. And when he has finally repeated this process 18 times he calls it an afternoon well employed and spends the evening telling his colleagues how he did it—provided he can find any colleagues who prefer to listen rather than to tell how they themselves whacked their own little white balls into 18 little sunken buckets. Or he may have to tell his story about what he did with his little white ball and the little sunken buckets to his patient wife, who can't get away. Science as well as golf is a sport to those who play the game and there is a chance of some bit of human value when the game is done.

In the promotion of human welfare through the advancement of science, scientists and the public have a common interest and may have a common share. I believe our association is especially adapted to furthering these common interests and could profitably undertake a study looking toward the development of a more effective program that would serve the aims of scientist and layman alike.

In this country as nowhere else patrons of art, literature and science have made investments in human good. The yields in benefits secured have varied much but sometimes have been slight because the investments have been unsound. We trust that those of philanthropic intent who wish to promote human welfare through the methods of science will subject their donations to as careful checks as they would a financial investment in order to ensure a profitable yield in the way of scientific dividends. A newly established National Science Fund is in position to serve as a clearing house for advice on the probable scientific dividends which may be expected from investments in science.

Although we do, each of us, live in different and more or less separate worlds of our own, I trust we

shall ultimately be able to acquire a social organization as orderly as the constellations of other worlds. In our fight for individuality and freedom in this war and in the peace to come, I do not despair. The experimental method has demonstrated we must use force without stint to show that freedom and political morality as well as personal honesty really pay. We still cherish the faith that the free search for truth by the methods of science has power to rebuild the world and will prevail.

OBITUARY

ERNEST EVERETT JUST

AUGUST 14, 1883, TO OCTOBER 27, 1941

IT is a sad task to write this short memorial of my former student, collaborator and friend, Professor E. E. Just, of Howard University in Washington. His death was premature and his work unfinished; but his accomplishments were many and worthy of remembrance.

Professor Just was of the Negro race and undoubtedly the best investigator in the field of biology that his people has produced in America. In person he was tall and slender, of dignified mien, with fine, sensitive features. He was born in Charleston, South Carolina, on August 14, 1883. His mother, who was a teacher, after providing him with the best elementary education that his state could furnish, sent him to Kimball Union Academy in New Hampshire, where he made a very distinguished record. He then entered Dartmouth College.

Just took his A.B. degree at Dartmouth College in 1907. While there he specialized in zoology under William Patten, made an excellent record in courses, and devoted a good deal of time to a research problem; he was elected to Phi Beta Kappa and received special honors in zoology and history, as well as the only "magna cum laude" in his class. He began his graduate training at the Marine Biological Laboratory in 1909 with the course in marine invertebrates, and in 1910 in embryology. In 1911–1912 he acted as research assistant to the writer on the subject of fertilization and breeding habits in Nereis and the sea-urchin Arbacia. These experiences focussed his interest on marine eggs, which remained the center of his investigations throughout life. His duties at Howard University delayed the completion of his work for the Ph.D. degree at the University of Chicago until 1916. In the meantime he completed six papers, based on work at Woods Hole in the summer. This work was so good, and his efforts during the academic years to improve medical education at Howard and other Negro universities so effective, that as early as 1915 he received the first award of the Spingarn Medal presented annually to "The man or woman of African descent who shall have made the highest achievement during the preceding year, or years, in any honorable field of human endeavor."

He was on the staff of Howard University from 1907 to 1941, since 1912 head of the department of zoology. From 1909 to 1930, with the exception of two years, he spent all his summers in work at the Marine Biological Laboratory.

His first paper (1912) was an interesting study in which he showed by an ingenious method that the plane of symmetry of development is determined by the polar bodies and the point of entrance of the spermatozoon in a meridian of the spherical egg of the annelid Nereis. This was followed by about fifty papers in the next twenty-five years dealing with fertilization and experimental parthenogenesis in marine eggs, mostly of annelids and echinoderms, in addition to a number of theoretical contributions. In 1939 he published two books; the first, on "Basic Methods for Experiments in Eggs of Marine Animals" (89 pp., P. Blakiston's Son and Company, Philadelphia), is an account of the very refined methods that he had developed for work in this field; the second, on "The Biology of the Cell Surface" (392 pp., same publishers), brings together his work and thought in the fundamental field of cellular physiology.

In the twenty summer sessions that Just spent at the Marine Biological Laboratory at Woods Hole he became more widely acquainted with the embryological resources of the marine fauna than probably any other person; and he learned to handle the material with skill and understanding. In consequence, he was in great demand, especially by physiologists who knew their physics and chemistry better than biology, for advice and assistance which he rendered generously. When he withdrew from Woods Hole to work in European laboratories, his loss to the scientific community at Woods Hole was deeply felt.

Just maintained a fine sense of balance in his biological work: he believed that "the study of the state of being alive is confined to that organization which is peculiar to it," but that "life as an event lies in a combination of chemical stuffs exhibiting physical properties; and it is in this combination, *i.e.*, its behavior and activities, and in it alone that we can seek life." These statements are taken from the introduction to his book on "The Biology of the Cell Surface" published only two years before his death. The emphasis in his studies was always on the biological plane, though in his experiments he availed himself intelligently of physical and chemical techniques.

His technical papers were characterized by intimate knowledge of material and use of it in its optimum state; he was thus able to avoid the pitfall of failing to distinguish between results due to unphysiological initial conditions and the real object of his experiments, *viz.*, the effects of altered physical and chemical conditions.

His observations and deductions led him to emphasize the reactions of the cortex ("ectoplasm") of eggs, and to assert their primacy not only in the initiation, but also in the course of development. This is the main theme of his last book. He conceived that the behavior of the ectoplasm is one prime factor in differentiation during development, and the building up of nuclear material another; there is constant interplay of both with the general protoplasm. This led to an interpretation of the action of the gene in heredity, and the conception was even extended to interpretation of evolution. "As the boundary, the living mobile limit of the cell, the ectoplasm controls the integration between the living cell and all else external to it. . . . It is keyed to the outside world as no other part of the cell. It stands guard over the peculiar form of the living substance, is buffer against the attacks of the surroundings and the means of communication with it."[1] Just thus regarded the surface of the cell as something much more than the "semi-permeable membrane" of the physiologists.

Just's scientific career was a constant struggle for opportunity for research, the breath of his life. He was condemned by race to remain attached to a Negro institution unfitted by means and tradition to give full opportunity to ambitions such as his. For this condition no blame is to be attached to the institution, which indeed cooperated by constant and prolonged leaves of absence with Just's friends outside in securing support to enable him to carry on investigations elsewhere. It was due to the National Research Council, Mr. Julius Rosenwald, the General Education Board, the Carnegie Corporation and the Rosenwald Foundation that Just was enabled to spend the greater part of his scientific life during repeated leaves of absence in research, at first largely at the Marine Biological Laboratory, and in the last ten or twelve years in various European laboratories: in Germany at the Kaiser Wilhelm Institut für Biologie in Berlin, in France at the Sorbonne and marine stations and in Italy at the Naples Zoological Station. The successive fellowships and research awards bear witness to the high esteem in which he was held as scientist. All these appointments were limited as to time, and Just never experienced the security of a life appointment adequate to carry out his work.

An element of tragedy ran through all Just's scientific career due to the limitations imposed by being a Negro in America, to which he could make no lasting psychological adjustment in spite of earnest efforts on his part. The numerous grants for research did not compensate for failure to receive an appointment in one of the large universities or research institutes. He felt this as a social stigma, and hence unjust to a scientist of his recognized standing. In Europe he was received with universal kindness, and made to feel at home in every way; he did not experience social discrimination on account of his race, and this contributed greatly to his happiness there. Hence, in part at least, his prolonged self-imposed exile on many occasions. That a man of his ability, scientific devotion, and of such strong personal loyalties as he gave and received, should have been warped in the land of his birth must remain a matter for regret.

FRANK R. LILLIE

[1] "Biology of the Cell Surface," page 366.

DEATHS AND MEMORIALS

DR. WALTER LINDSAY NILES, professor of medicine and acting dean of Cornell University Medical College, New York, died on December 23 in his sixty-fourth year.

DR. WILLIAM PITT DURFEE, emeritus professor of mathematics and emeritus dean of Hobart College, died on December 17 at the age of eighty-six years.

THE death is announced of Dr. Filippo Bottazzi, professor emeritus of physiology at the University of Naples. Dr. Bottazzi was president of the fourteenth International Congress of Physiology which was held in Rome from August 29 to September 3, 1932.

Nature reports the death on November 12, at the age of eighty-four years, of Dr. E. S. Beaven, the agricultural botanist and plant breeder.

A BRONZE plaque has been hung in the main building of the University of Texas School of Medicine, Galveston, in memory of the late Dr. Meyer Bodansky, who at the time of his death in June was professor of pathologic chemistry at the university. He had been a member of the faculty since 1919.

IT is reported in the *Journal* of the American Medical Association that a bronze statue of the late Drs. William J. and Charles H. Mayo in their surgical gowns will be the central point of interest of the Mayo Memorial Shrine to be erected in Rochester by residents of the city and Olmstead County. It will be placed on a granite base before a granite background in the central open space of an amphitheater, symbolic of operating rooms. The shrine, designed by James Earle Fraser, New York sculptor, will be separate from that being planned by the Minnesota Memorial Commission. This commission was ap-

pointed by Governor Stassen late in 1940 to study the establishment of a $250,000 fund for a memorial to the Mayos. State Senator William B. Richardson, Rochester, is chairman of the commission, which is composed of seventeen representative citizens of Minnesota.

SCIENTIFIC EVENTS

AN INDUCTION ACCELERATOR

THE University of Illinois announces that it has arranged for the installation of a machine which opens new fields for scientific exploration and which, as a super x-ray, has important possibilities in medicine, industry and national defense.

It was invented by Dr. Donald W. Kerst, of the department of physics. The machine is the second of its kind, and is ten times as powerful as the first machine, which was built a year ago. Dr. Kerst was given leave of absence to enable him to superintend its construction at the laboratories of the General Electric Company in Schenectady, N. Y.

The machine is called an induction accelerator. It accelerates electrons to an energy of twenty million volts and also emits x-rays of this power. This radiation exceeds that from the existing supply of radium. The x-ray radiation is twenty times as powerful as the x-ray machines now used in hospitals and factories. The machine will be installed at the university in the new Abbott power plant.

With the induction accelerator, electrons are accelerated to a speed nearly that of light—186,000 miles a second.

Dr. W. D. Coolidge, director of the laboratories of the General Electric Company, points out that the induction accelerator provides an important new tool for fundamental research. His statement reads:

> Hitherto, experiments with high velocity electron beams have not kept pace with experiments done with positive ions from the cyclotron. The cyclotron can not accelerate electrons, and previous devices able to do so have seemed to reach a practical limit at something like one fourth the energy output of the new induction accelerator built in the General Electric laboratories for the University of Illinois.
>
> The induction accelerator seems to have no limit. Apparently its effective voltage can be increased indefinitely. It works not by applying the entire voltage at once, but by building up the speed throughout all revolutions.

It is announced that plans are now being considered for an induction accelerator to create 100- or 200-million volts energy.

THE NATIONAL INVENTORS COUNCIL

RECENT short-wave broadcasts from Europe and American responses thereto have centered attention upon the part which inventions are playing in the present war.

In response to this movement, Dr. William B. Coolidge, of the National Inventors Council of the Department of Commerce, stated that the council has already examined more than 35,000 inventions and suggestions during the past year, and that of those examined, several were of extreme import and might possibly affect modern warfare.

The inventions referred to include only those which have been received by the Inventors Council. When consideration is given to the work and achievements of the Office of Scientific Research and Development and of other Government agencies engaged in defense research and development work, it is apparent that the nation's inventive genius is contributing its share to the defense effort.

Lists have been made available by the War Department suggesting fields in which new ideas would be welcome. Among these are:

- Hydrocarbon vapors as an explosive.
- Rocket-propelled projectiles.
- Air, centrifugal and electromagnet guns.
- Automatic mines for land and sea.
- Searchlights, mobile landing-field flood lighting.
- Special automotive equipment for simplifying servicing of motor vehicles and aircraft, and improved motorized repair-shop equipment.
- Improved tank design.
- Better aircraft brakes.
- Light, protective armored clothing.
- Improved automatic anti-aircraft guns and small arms.
- Aircraft catapults and retarding device.
- Ice-prevention devices.
- Refueling equipment.
- Remote-controlled aerial and marine torpedoes, land vehicles and ships, and remote control for other combat weapons.
- Improved gun- and bomb-sights, optical and otherwise.

THE NATIONAL ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL

THE following statement has been received from the National Roster:

The National Roster of Scientific and Specialized Personnel is now conducting a survey of the senior and graduate students of chemistry and chemical engineering in the universities of the country. It is urged that all persons with training in this or any other scientific or professional field register with the National Roster as soon as possible.

The registers of this organization, containing the

names of the scientific and professional individuals of the nation, are of the utmost importance in our present crisis. They must be replenished and kept current in order that there will always be a supply of trained men and women to handle any situation or carry on any research which is essential to our war effort. Registering with the National Roster is one way in which the trained individual can do his part. There may never arise an occasion where an individual would be asked by the Government to serve. On the other hand, there may be a time when persons with certain skills will be vital to the welfare of the nation either as full-time workers, part-time workers, or as consultants. Nothing has ever been lost through preparedness. Therefore, it is again urged that all with special training register immediately with the National Roster of Scientific and Specialized Personnel at Washington, D. C. This can be accomplished by writing to the National Roster of Scientific and Specialized Personnel in Washington, asking for necessary blanks. Also the required forms are being distributed to senior classmen in the country's colleges and universities.

THE LUCIUS N. LITTAUER FUND OF NEW YORK UNIVERSITY

NEW YORK UNIVERSITY has received nearly a quarter million dollars from Lucius N. Littauer. The gift will be used to establish "The Lucius N. Littauer Fund" in the College of Medicine. The income will be expended, as Mr. Littauer designated, "for research in psychiatry, neurology and related fields, in order to increase and diffuse knowledge of the biological and other factors which influence thought and conduct; and thereby to prevent and correct abnormal human behavior through experimental and clinical approaches."

A statement made by Chancellor Harry Woodburn Chase in regard to the gift, reads:

> A fair yet liberal part of the income will be devoted to fellowships for graduate students in medicine of superior ability, to be known as "Littauer Fellows," to be trained to practice psychiatry and those branches of medical science concerned with the activities of the mind and factors influencing it, thereby recruiting physicians specially devoted to the conservation and restoration of mental health.
>
> We have a very deep appreciation of this generous gift by Mr. Littauer. For many years he has been interested in our College of Medicine and has given generously toward the support of special projects. This larger gift, coming at such a time, is heartening indeed. It is the first substantial gift which has been made to any university since our entry into the war and I can but see in it striking witness of the fact that intelligent and far-sighted citizens will not falter in their support of the purposes of higher education through this emergency.

Mr. Littauer had previously given the university nearly $120,000 for research on the prevention and cure of pneumonia; on venereal diseases, and for scholarships and fellowships in the College of Medicine, Washington Square College of Arts and Science, the College of Dentistry and other divisions of the university.

Mr. Littauer, president of the Gloversville Knitting Company and Fonda Glove Lining Company, is a former member of Congress from New York, and from 1912 to 1914 was a Regent of the University of the State of New York.

THE OBSERVATORY OF THE BUHL PLANETARIUM

THE Buhl Planetarium and Institute of Popular Science at Pittsburgh opened its new $30,000 People's Observatory on November 19. According to *Museum News,* the observatory is on the third floor of the planetarium, in two rooms separated from each other by a glass partition. The outer room, open to the air, contains the objective lens and mirror of a siderostat telescope; the inner room, kept at constant 72-degree temperature, contains the eyepiece and controls of the telescope. The objective lens, 10 inches in diameter, was made of glass imported from Europe and ground in America. There are six eyepieces ranging from 65 power to 490 power. A 12-foot horizontal steel tube supports the lens system and keeps out stray light. All this part of the telescope remains stationary. The image of the star or planet being observed is reflected to the lens by an aluminum-coated pyrex mirror 18 inches in diameter which can be set to follow automatically the movement of the celestial object. Nine electric motors power the control apparatus, which can direct the mirror to any part of the sky. The apparatus can even be set to find automatically the object wanted: the observer determines from a guidebook the celestial latitude and longitude of the object, sets the controls for that location, and starts the mirror moving; when the mirror stops the desired image appears in the eyepiece and a press on a button makes the mirror follow the movement of the object automatically. The observer stands or sits in a normal position and looks through the always horizontal apparatus; the mirror does all the adjusting. A recorded voice tells the spectator the story of the object being observed. The telescope was built by the Gaertner Scientific Corporation of Chicago.

The dedicatory address was delivered by Dr. Harlow Shapley, director of the Harvard College Obser-

vatory. Other addresses were made by William S. Linderman, president of the Buhl Foundation; Charles L. Lewis, director of the foundation and president of the planetarium, and Arthur L. Draper, director of the planetarium. The dedicatory program included a radio program by Dr. Shapley and Mr. Draper; a showing of the exhibit, "Can America Be Bombed?" from the Science Museum of the Saint Paul Institute, and a preview of a new sky show, "Bombers by Starlight," depicting by special apparatus, designed by the planetarium staff, the balloon barrage, blackout, fires started by bombs, glider and parachute attacks, and masses of aircraft overhead, with realistic sound effects recorded in London and Dover.

THE LIBRARY OF THE MARINE BIOLOGICAL LABORATORY AT WOODS HOLE

THE Carnegie Corporation of New York has recently granted to the Marine Biological Laboratory the sum of $25,000 to be used primarily to complete various back sets of journals and to add to its collection of books, particularly those which may be termed "classics" in biology and allied sciences. By means of this gift, the library, already notable for its periodicals, books and reprints, will presently be able to provide investigators with complete runs of all the important biological journals, and of many covering chemistry, physics, paleontology, radiology, medicine and other sciences allied to biology.

During recent years the library has enjoyed rapid growth. In 1920 the number of serials received was 153; now it is 1,257. The collection of reprints has increased from 8,500 to 120,000. So great was the expansion that the stack space provided in the building erected in 1925, and supposedly adequate for many years, was completely filled in 1940. At that time, the Rockefeller Foundation provided funds for a much-needed addition. The building, which more than doubles the original space, was quickly completed, and the serials and reprints were spread out in their more adequate quarters before the summer session of 1941. Every effort has been made to enable the reader to find for himself the volume that he wants. The journals are arranged in alphabetical order, and the reprints filed under the author's name. A complete bibliography of the author is thus instantly available. Commodious and well-lighted tables are conveniently located on each of the stack tiers in the new wing.

The library is in constant use, day and night, by those who are carrying on active research, and by an increasing number of those who come for the sole purpose of consulting biological literature. Thanks to the generosity of the Carnegie and Rockefeller Foundations, which have in former years greatly helped the Marine Biological Laboratory, the library is now adequately housed, and is enabled to increase its usefulness to the investigator.

THE MEDICAL MUSEUM OF THE ROCHESTER ACADEMY OF MEDICINE

ACCORDING to the *Journal* of the American Medical Association, the Rochester Academy of Medicine rededicated its medical museum to Dr. John R. Williams, chairman of the museum commission, on November 16. A reception to guests opened the program and speakers included Dr. William J. Merle Scott, president of the academy; Dr. George H. Whipple, professor of pathology and dean, University of Rochester School of Medicine and Dentistry; Dr. Walter B. Cannon, George Higginson professor of physiology and head of the department, Harvard Medical School, and Dr. Williams. The museum and auditorium are located in a new wing adjoining the academy, which was the gift in 1938 of the daughters of E. P. Lyon, in memory of their parents. A feature of the medical museum is a memorial frieze in which is recognized the fundamental contributions made by twenty-four North American scientific men in the past hundred and fifty years. Those honored in the frieze are: Dr. Benjamin Rush, Philadelphia; Dr. William Beaumont, St. Louis; Dr. Crawford W. Long, Athens, Ga.; Dr. William T. G. Morton, New York; Dr. Oliver Wendell Holmes, Cambridge, Mass.; Dr. Ephraim McDowell, Danville, Ky.; Dr. Silas Weir Mitchell, Philadelphia; Dr. Edward L. Trudeau, Saranac Lake, N. Y.; Dr. Theobald Smith, Princeton, N. J.; Dr. Howard T. Ricketts, Chicago; Dr. Hans Zinsser, Boston; Dr. Harvey Cushing, New Haven, Conn.; Lafayette B. Mendel, New Haven, Conn.; Elmer V. McCollum, Baltimore; Dr. William C. Gorgas, Washington, D. C.; Dr. Walter Reed, Washington, D. C.; Dr. Abraham Jacobi, New York; Dr. William Osler, Oxford, England; Dr. Walter B. Cannon, Boston; Dr. James B. Herrick, Chicago; Dr. Frederick G. Banting, Toronto; Dr. Charles H. Best, Toronto; Dr. George R. Minot, Boston, and Dr. Whipple.

Another feature is a mural in which is portrayed the contributions of medicine to modern civilization. There are in the museum twenty-three glass cases of priceless memorabilia. In 1936 the medical museum of the Rochester Academy of Medicine was organized as a division of the Rochester Museum of Arts and Sciences.

SCIENTIFIC NOTES AND NEWS

MEMBERS of the American Association for the Advancement of Science and of the Associated Scientific Societies meeting this week at Dallas under the presidency of Dr. Irving Langmuir, of the General Electric Company, were addressed on Monday evening by Dr. Albert F. Blakeslee, the retiring president, whose address appears in this issue of SCIENCE. Others of the more important addresses and papers presented at the meeting will be published in ensuing weeks. Dr. F. R. Moulton, the permanent secretary, expects to contribute an account of the meeting to the issue of SCIENCE of February 6, all the space of that number being reserved for it.

PRESIDENT E. O. LOVETT, of the Rice Institute, formerly professor of mathematics and astronomy at Princeton University, has retired with the title president emeritus at the age of seventy years.

VICE-PRESIDENT WALLACE, on behalf of President Roosevelt, presented on December 17 the 1940 Collier Aviation Trophy jointly to Dr. Sanford A. Moss, engineer of the General Electric Company, and to the Army Air Corps, for "outstanding success" in developing the turbo-supercharger, an engine device which makes possible high altitude flying.

THE *Journal* of the American Medical Association reports that Dr. Edward H. Juers, of Red Wing, Minn., recently received the annual medal of the Southern Minnesota Medical Association for his paper on epiploitis. The medal is given to the author of the paper considered best on the program of the annual meeting. The medal for a case history presented on the annual program was awarded to Dr. Peter E. Hermanson, of Hendricks, whose report dealt with a case of pregnancy occurring outside of the uterus.

THE first Charles Chree medal and prize of the Physical Society of London has been awarded to Professor Sydney Chapman, of the Imperial College of Science and Technology.

E. A. HOLBROOK, dean of the Schools of Engineering and Mines at the University of Pittsburgh, was elected at the Pittsburgh meeting president of the National Society of Professional Engineers, succeeding John H. Beretta, of San Antonio, Texas. Other officers elected were Samuel I. Sacks, Philadelphia; Alfred E. Roche, Troy; William R. Wolfe, Muskogee, Okla., and Joseph H. Morgan, Urbana, Ill., *vice-presidents,* and Colonel Walter L. Simpson, Army Engineering Corps, *treasurer.*

THE *Bulletin* of the American Mathematical Society reports that Associate Professor R. V. Churchill, of the University of Michigan, is on leave of absence for the first semester of 1941–42 and is visiting lecturer at the University of Wisconsin. Assistant Professor C. H. Fischer, of Wayne University, is this year visiting assistant professor of mathematics at the University of Michigan.

DR. GEORGE L. GRAHAM, of the Rockefeller Institute for Medical Research, Princeton, N. J., on December 18 addressed the Zoology-Entomology Seminar of Kansas State College on "Biological Studies with the Nematode *Strongyloides ratti.*"

DR. WALTER L. PALMER, professor of medicine of the School of Medicine of the University of Chicago, delivered on December 3 the fifty-fourth Thomas Dent Mutter Lecture before the College of Physicians of Philadelphia. His subject was "The Rôle of Acid Gastric Juice in Gastric and Duodenal Ulceration."

DR. KENDALL B. CORBIN, associate professor of anatomy, histology and embryology at the College of Medicine of the University of Tennessee, has been appointed chief of the division of anatomy, histology and embryology and acting head of the department of anatomy. He succeeds the late Dr. August H. Wittenborg, who also served as professor of anatomy at the school.

DR. THOMAS D. SPEIDEL, editor of *The Journal of Dental Education* and formerly of the Iowa State University, has joined the faculty of the School of Dentistry of Indiana University.

DR. CARL A. NAU, formerly director of the Texas Division of Industrial Hygiene, has become professor of physiology and preventive medicine and head of the department at the School of Medicine of the University of Texas.

DR. GEORGE F. FORSTER, assistant chief of the Division of Laboratories in the Illinois Department of Public Health, has been appointed associate professor of bacteriology in the Loyola University School of Medicine.

DR. CHARLES RAY, JR., research fellow of the Blandy Experimental Farm, has been appointed geneticist at the Central Fibre Corporation, Pisgah Forest, N. C. Dr. Ray has been awarded the second prize by the Walker Prize Committee for his paper on "Cytological and Genetic Studies on the Flax Genus, *Linum.*"

HARRY L. ERLICHER, vice-president of the General Electric Company in charge of purchasing activities, has been named a member of the Defense Industries Advisory Committee of the Copper and Zinc Indus-

tries, a division of the Office of Production Management.

DEAN HARVEY, materials engineer, Engineering Laboratories and Standards Department, Westinghouse Electric and Manufacturing Company, is serving on a part-time basis on loan from his company as consultant in the Specifications Branch of the Bureau of Industrial Conservation, his services having been requested by the director of the bureau, Lessing Rosenwald.

EMERITUS PROFESSOR RALPH STOCKMAN has been elected a vice-president and Professor E. W. H. Cruickshank and Sir J. Donald Pollock have been made members of the council of the Royal Society of Edinburgh.

The Ohio State University Monthly reports that Dr. N. Paul Hudson, chairman of the department of bacteriology, has returned to the university after a year's leave of absence spent in London as a representative of the Rockefeller Foundation, in a collaborative scheme with the British to distribute influenza vaccine. He was associated there with the National Institute of Medical Research, Hampstead.

SEÑOR G. A. JORQUERA, professor of agricultural chemistry in the School of Chemical Engineering, University of Concepcion, Chile, is spending the academic year 1941–42 at the Oregon State College as a Phi Beta Kappa fellow. He is engaged in work leading to an advanced degree in chemistry and chemical engineering.

MAJOR THOMAS COULSON, director of public relations of the Franklin Institute, will address a public meeting of the Philadelphia Branch of the American Association of Scientific Workers on January 16 at 8:15 P.M. His subject will be "The Franklin Institute, Its Purposes, Achievements and Problems."

MATTHEW W. STIRLING, chief of the U. S. Bureau of American Ethnology at the Smithsonian Institution, delivered on November 27 before the Washington Academy of Sciences an illustrated address entitled "Treasure Trove of Mexican Archeology."

DR. WILLIAM SEIFRIZ, professor of botany at the University of Pennsylvania, lectured on December 2 before the Torrey Botanical Club at the American Museum of Natural History, New York. His subject was "Recent Advances in the Study of Protoplasm."

DR. KARL F. MEYER, of the George Williams Hooper Foundation for Medical Research, University of California, San Francisco, gave an address before the Minnesota Pathological Society on December 16. He spoke on "The Animal Kingdom, a Reservoir of Infection." The society was addressed on November 18 by Dr. Melvin H. Knisely, Chicago, on "Effects of Plasmodium Malariae on the Blood Vascular System."

THE twenty-fourth annual meeting of the American Society of Mammalogists will be held at the American Museum of Natural History, New York City, from Tuesday, March 31, to Saturday, April 4. Titles of papers for presentation at the meeting must be in the hands of the corresponding secretary of the society, Emmet T. Hooper, of the Museum of Zoology of the University of Michigan, before March 1. Those submitting titles should include an abstract of the paper, the time required for presentation and the projection apparatus needed. Further details regarding the meeting may be obtained from the corresponding secretary or from the local committee on arrangements: H. C. Raven, *chairman,* Edwin H. Colbert, John Eric Hill and Claude Leister, of the American Museum of Natural History, New York.

A FORUM sponsored by the New York branch of the American Association of Scientific Workers on Venereal Disease Problems in the Army and Civilian Defense Areas will be held on January 7 at 8:15 P.M. at the Men's Faculty Club, Columbia University. The speakers will be Lieutenant Colonel Edward H. Marsh, Office of the Surgeon, 2nd Corps Area, U. S. Army, and Dr. Roger E. Heering, P. A. Surgeon, U. S. Public Health Service, District No. 1. Dr. Ernst P. Boas, assistant professor of clinical medicine, College of Physicians and Surgeons, Columbia University, will act as chairman.

THE American Congress on Obstetrics and Gynecology will be held in St. Louis from April 6 to 10. The committee sponsoring the congress has attempted to unite the efforts of voluntary and other agencies to carry out plans for the care of women and children. The directors believe that, notwithstanding the war situation, the congress should be held at the stated time. Inquiries may be addressed to the central office, 650 Rush St., Chicago, Ill.

DURING the first year of the war, the British Genetical Society, which has a membership of 146, held only its annual meeting. From the summer of 1941 it has resumed its normal activities. Two successful meetings have been held at the Rothamsted Experimental Station and at Oxford. On each occasion papers were read and a considerable series of exhibits were demonstrated. Although winter meetings are still impossible, it is hoped to commence a full program next year with a meeting in the early spring. The present officers of the society are: *President,* R. A. Fisher; *Vice-presidents,* C. D. Darlington, J. S. Huxley, R. N. Salaman; *Treasurer,* E. R. Saunders; *Secretaries,* K. Mather, E. B. Ford.

THE National Live Stock and Meat Board will place grants and establish fellowships through the National Research Council for the purpose of increasing the present knowledge of nutrition. The grants may be made either for fundamental or for clinical research on the nutritional properties of meat, meat products and animal fats, and the importance of these nutrients to human health and welfare. This fund will become available on July 1. Applications will be received until March 1. Application blanks may be obtained from the Division of Biology and Agriculture, the National Research Council, 2101 Constitution Avenue, Washington, D. C. In addition to a statement of the problem and research plan or program, the committee in charge desires information regarding the method of attack proposed, the institutional support which will be given the investigation and the uses to be made of the sum requested. No part of a grant may be used by the recipient institution for administrative expenses.

THE Graduate School of the University of Illinois has established four research fellowships in the fields of medicine and dentistry in Chicago at a stipend of $1,200 per year. Fellows are eligible for reappointment in competition with the new applicants. Candidates for these fellowships must have completed a training of not less than eight years beyond high-school graduation. Formal application blanks may be secured from the Secretary of the Committee on Graduate Work in Medicine and Dentistry, 1853 W. Polk Street, Chicago, Illinois.

THE General Education Board of New York City has granted $53,750 to the Louisiana State University for the use of the department of forestry. Of this amount $23,750 will be used for equipment and $30,000 for research, the latter to be expended over a period of three years and to be paid to the university semi-annually. The grant will provide funds for completing the equipment of three utilization laboratories and it is said will give the unit "the most complete utilization equipment, both for teaching and research, of any forestry school in the South." It is planned to study forest land tenure and the effect of such tenure on forestry practices.

PAUL KOLLSMAN, of Greenwich, Conn., the aircraft instrument inventor, has established a fund of $65,000 to endow a library for lending aeronautical books to students of aviation.

Nature states that under the will of Alfred Corner, London, who died in 1934, the university has received £1,440 for the purposes of the Cambridge University Biochemical Laboratory. The full value of the bequest, of which this is an instalment, may approach £1,800.

THE Hungarian Ministry of Internal Affairs has established at Budapest a new institute for research in proper feeding. The building and equipment are modern and will accommodate two hundred country doctors, who will attend courses in the science of nutrition. The staff of the institute comprises clinicians, chemical experts, economists and financial experts.

THE Imperial Agricultural Bureaux, Aberystwyth, Wales, has decided that for the sake of increased efficiency and economy, all work connected with subscriptions, sales and distribution of the journals and other publications of the majority of the bureaux should now be centered in one office. For this purpose, a Central Sales Branch has been organized, with its offices at the Agricultural Research Building, Penglais, Aberystwyth. In future all correspondence dealing with sales and distribution should, with the exceptions noted below, be so addressed. Correspondence on all other matters must still be addressed to the deputy director of the bureau in question. The only publications not dealt with by the Central Sales Branch are those of the Imperial Institute of Entomology (The Assistant Director, Imperial Institute of Entomology, 41 Queen's Gate, London, S.W.7) and the Imperial Mycological Institute (Director, Imperial Mycological Institute, Ferry Lane, Kew, Surrey), and *Nutrition Abstracts and Reviews* (Secretary, Imperial Bureau of Animal Nutrition, Rowett Institute, Bucksburn, Aberdeen).

DISCUSSION

SYMBOLS FOR HUMAN GENES

STANDARDIZATION of symbols for human genes has desirable aspects, as Dr. Strandskov[1] suggests. An International Committee for the symbolizing of genes and chromosome aberrations in all genetic work met in London in August, 1939, and drew up certain rules which have been published.[2] The committee also had under consideration the definition of all genetical terms, but owing to the war that work has not been completed. The Committee on Mouse Genetics Nomenclature has also published a report.[3] The symbols recommended in these reports are not quite the same as those which Dr. Strandskov advocates. For instance, + is used as a superscript to the symbol for the "wild" type.

[1] SCIENCE, 94: 366, 1941.
[2] *Jour. of Hered.*, 31: 27, 1940.
[3] *Jour. of Hered.*, 31: 505, 1940.

These symbols are at least in part applicable to human genetics, but they were drawn up with the needs of experimental genetics particularly in view; and it would be unwise to try to hasten their adoption in human genetics except where their use would help to clarify a particular genetical situation. While there are groups of human alleles which might with advantage receive this symbolization, there are many more where the question of allelomorphism is by no means settled, so that the bulk of such cases must await fuller knowledge.

While it is generally agreed that the AB blood groups are alleles, yet I think the choice of the blood groups as a field to which the new nomenclature should be applied was particularly unfortunate. In the first place, the final form which blood group genetics may take is by no means certain; for instance, as regards the nature of the O and the relations of the A_1, A_2, A_3 and B_1, B_2, B_3 sub-groups. This can perhaps be most clearly seen by consulting, for example, the recent paper of Hirszfeld and Kostuch.[4]

A decade ago anthropologists and serologists adopted internationally the symbols O, A, B, AB for the four human blood groups. These are preferable to the I, II, III, IV schemes of Moss and of Jansky, which partly conflict with each other and have been the source of serious and even fatal errors in connection with blood transfusion in hospitals. The medical profession appears to be gradually giving up this number system and adopting the safer and better ABO system, which is sufficiently genetical for their purposes. It can not be expected that medical practitioners and anthropologists will have an expert knowledge of genetics, although a general knowledge is of course highly desirable.

Geneticists should therefore endeavor to hasten the spread of the ABO system in medical circles. The adoption by geneticists of a new and obscure set of symbols for the blood groups would defeat this end and make their papers on the subject unintelligible to the anthropologists and medical men, for whom the genetical aspects of blood group work should have the greatest appeal.

R. RUGGLES GATES

UNIVERSITY OF LONDON,
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WOODS HOLE, MASS.

SOME FIELD OBSERVATIONS BEARING ON THE ORIGIN OF THE MORRISON "GASTROLITHS"

DESPITE numerous finds of genuine gastroliths in association with remains of fossil vertebrates, a causal relationship between the dinosaurs and so-called "gizzard-stones" of the Morrison formation remains doubtful. The origin of these brilliantly colored and highly polished stones has been speculated upon by numerous observers and opinion has been divided among various theories, not the least attractive and popular of which attributes the polish to the mechanical and chemical action of dinosaurian digestion.

Recent field work, sponsored by the William Berryman Scott Research Fund, on the larger problems of Morrison stratigraphy over extensive areas in Utah, Colorado and southern Wyoming has brought out several facts regarding the distribution and occurrence of these stones which may be significant:

(*a*) Within the Morrison the association of dinosaur remains and "gastroliths" seems entirely fortuitous. Where tremendous quantities of fossil bones are found as at the Dinosaur National Monument, near Jensen, Utah; at the Malcolm Lloyd Jr. quarry near Cleveland, Utah, and at the Como Bluff and Bone Cabin quarries in southern Wyoming there is no unusual concentration of "gastroliths." In fact, during recent excavations at the Lloyd quarry not a single stomach-stone was found among the remains of a dozen or more dinosaurs, including Antrodemus, Ceratosaurus, Stegosaurus, Ornitholestes, Camptosaurus and two large sauropods. Furthermore, great quantities of "gastroliths" may occur, constituting at places a veritable conglomerate, without fossil bones being in evidence.

(*b*) In the Colorado Plateau the "gastroliths" occur only in the upper portion of the Morrison in beds which are relatively barren of fossils and which show some lithic differences from the underlying fossiliferous portion of that formation. "Gastroliths" are found most abundantly in thin zones or "stringers" near the base of this upper unit. The rock types making up the "gastroliths" are identical with those found in a persistent but thin conglomerate between the two units just mentioned and the inference seems logical that regardless of the origin of their polish the stones were derived from the same source as the conglomerate or from the conglomerate itself.

(*c*) The distribution of the "gastroliths" is by no means coextensive with the Morrison formation as none were found in that formation south of a line running roughly from the Henry Mountains, Utah, to the Black Canyon of the Gunnison River in Colorado. Likewise a hurried search failed to reveal any east of the Front Range. The geographical distribution seems to coincide quite closely with that of the conglomerate noted above. Dinosaur bones, however, are present in the usual numbers in regions where "gastroliths" are absent.

The facts listed above, in conjunction with others apparent from a close comparison of the "gastroliths" of the Morrison with undoubted stomach-stones, seem unfavorable to the dinosaur hypothesis, but it is admitted that there are many peculiar facts of distribution which are difficult to explain by any theory.

[4] Über das Wesen der Blutgruppe O. *Klin. Wochenschr.*, 17: 1047–51, 1938.

The field relationships suggest that the "gastroliths" were originally stream or pediment gravels and that the high polish was superimposed by the action of wind-blown dust upon surfaces already smoothed and rounded by other agencies. It should be noted that the Morrison shales are highly bentonitic and must have contained a high proportion of sharp, volcanic, glass shards which would have been very potent abrasives at the time of deposition. The stones probably accumulated by deflation in the same manner as modern "desert armor" and the bright coloration may be due to prolonged exposure to weathering. The lack of faceting, case hardening and pitting is by no means a fatal objection as these seem to result from local and specialized conditions and do not always accompany wind erosion.

Until a connection between the dinosaurs and these highly polished stones is proved it seems advisable to abandon the term "gastroliths" in favor of some non-committal designation. The term "Morrison stones" may be used in a sense analogous to the "Gobi stones" of the Asiatic Irdin Manha formation, the two occurrences being in many ways similar.

W. LEE STOKES

DEPARTMENT OF GEOLOGY,
PRINCETON UNIVERSITY

THE SMYRNA FIG IN CALIFORNIA

IN SCIENCE (94: 339), it is stated that Dr. Gustav Eisen introduced the Smyrna fig into California. This is an error. Cuttings from Smyrna were brought into California at the instance of G. P. Rixford, in 1880, and also in much earlier years, perhaps in the 1850's, by other persons of whom there is no record. None of these trees matured fruit, which led Dr. Eisen to believe the failure was due to lack of pollination (caprification), a surmise confirmed by an experiment in artificial pollination first made by George C. Roeding at Fresno in 1890. Pollen from a caprifig tree was inserted with a goose quill in young figs of a Smyrna tree. The figs matured and became fully ripe. Eisen himself, in 1895, carried pollen from caprifigs, in a sealed glass container, to Smyrna fig trees two hundred miles distant in the upper San Joaquin Valley in Kern County and pollinated young figs. This experiment proved completely the need of caprification. In the course of time Eisen and his former associate, Mr. Roeding, interested the United States Department of Agriculture in the problem and through the department's agents a colony of the blastophaga wasp was sent from Algiers to California in 1898. The introduction of the wasp proved successful and the growing of Smyrna figs was soon established on a commercial basis. Blastophagae had been previously introduced by fig growers but apparently were a failure.

Eisen's monograph on the biology of the fig[1] may be considered classical and is still consulted by students and by horticulturists.

WILLIS LINN JEPSON

UNIVERSITY OF CALIFORNIA

AEDES AEGYPTI LINNAEUS, THE YELLOW FEVER MOSQUITO, IN CENTRAL MISSOURI

LATE in September mosquito larvae were found in a small aquarium in the office of the State Health Commissioner. These were taken to the Laboratory of the State Department of Health where, on October 4, 1941, an adult emerged that proved to be of this species.

This location, Jefferson City, is near the center of the state, about 38.6 degrees north latitude, and probably is the "fartherest north" for the species in Missouri.

C. F. ADAMS

MISSOURI STATE DEPARTMENT OF HEALTH,
JEFFERSON CITY

QUOTATIONS

THE WORK OF THE ROCKEFELLER FOUNDATION IN BRAZIL

THE twenty-fifth anniversary of the beginning of the work of the International Health Board of the Rockefeller Foundation in Brazil has been enthusiastically commemorated. Besides articles in newspapers and in medical magazines, some medical associations have held special meetings to honor that humanitarian institution. The most brilliant of these meetings was one promoted by the oldest medical association of Brazil, the National Academy of Medicine. Under the chairmanship of Professor Aloysio de Castro of the University of Rio de Janeiro Medical School the academy held a crowded meeting to honor the Rockefeller Foundation in the person of Dr. Fred L. Soper, its representative in Brazil. The principal speaker was Dr. Afranio Peixoto, professor of hygiene at the university, who reviewed the most salient facts in the services rendered by the foundation especially in the fields of medical education, public health nursing, instruction of sanitarians and the investigation and control of yellow fever, malaria and hookworm disease. Two medical commissions were sent to Brazil early in 1916, the first under Major

[1] Proceedings of the California Academy of Sciences, ser. 2, 5: 897–1003, 1896.

General William C. Gorgas, to study the yellow fever situation, and the second, composed of Drs. Richard M. Pearce, John A. Ferrel and Bailey K. Ashford, to survey the grounds of medical education, hospitals and dispensaries, public health agencies and sanitary progress. In the same year an effective cooperation began with the Brazilian National Department of Health and with the São Paulo University, growing little by little and leading to the great development resulting in the medical and public health institutions and services now in operation. One lasting result of this cooperation is the University of São Paulo School of Medicine, now housed in a magnificent building of many stories and provided with a faculty of distinguished professors. It is a long work begun with the cooperation of Drs. Samuel T. Darling and Wilson G. Smillie, whose services were an honor to American medical science. To-day the São Paulo school is one of the best on the American continent, and its department of hygiene is a leading institute of scientific research in the country. In the field of public health too the cooperation of the Rockefeller Foundation was of the greatest value. The work against hookworm disease begun in 1916 and greatly developed since 1920 has led to the creation of many modern county health units. With the cooperation of the foundation in 1922 the first training school for nurses was founded in Rio de Janiero, and a Nursing Division was started in the department of health of the city with an able body of ten American public health nurses as supervisors. This led to the creation of a few training schools for nurses in several cities of a large country where the professionally trained nurse was completely unknown before. The nursing service of the department of health of Rio de Janeiro is now an efficient and popular modern agency of health. With the help of the International Health Board of the Rockefeller Foundation, the School of Hygiene and Public Health of the Johns Hopkins University lent the services of two able professors, Drs. Allen W. Freeman and James A. Doull, to start a course of instruction for sanitarians in the medical school of Rio de Janeiro, and the foundation granted fellowships to many Brazilian public health workers, who went to the United States to study at leading American schools and to visit different public hea organizations.

With the support of the Rockefeller Foundatio complete survey of the yellow fever situation de oped in the discovery of the jungle form of the d ease, the disclosure of sylvatic mosquito vectors o than Aedes aegypti (as Hemagogus capricorni Aedes escapularis), the invention of the viscerot as the leading means of postmortem diagnosis yellow fever and, through the work of the Rockefe Institute, the creation of an efficient vaccine, now jected into millions of people, thus protected aga the sylvatic yellow fever, as the only practical prop lactic resource. Brazil is also indebted to the Ro feller Foundation for the help in the fight aga Anopheles gambiae, the worst vector of malaria, ported into Brazil from the west coast of Afr Some species of anopheles are more susceptible to fection than others; some anopheles mosquitoes not bite man at all; others will bite man only w other animals are not available. Anopheles gamb of Africa, which had spread through the states Rio Grande do Norte and Ceara, entering the g airport of Natal, Brazil, has probably the highest fectibility and the greatest preference for man of Anophelines. This makes that species the most portant vector of malaria in man. The intensive c paign against the gambiae conducted by the mal service of the Brazilian health department with as tance in funds and personnel from the Internati Health Board of the Rockefeller Foundation is an standing example of "species sanitation." The sures concentrated on were those which would prev the breeding of gambiae. The eradication of the ported Anopheles gambiae is a paramount example what is possible through the use of modern a malarial technic, available to the Brazilian health thorities through the invaluable cooperation of Rockefeller specialists.

Professor Peixoto praised the humanitarian work the Rockefeller Foundation in Brazil and comment Dr. Soper for his ability to win the friendship Brazilian physicians, thus insuring once more unity of the Americas.—*Rio de Janeiro Correspond of the Journal of the American Medical Associati*

SOCIETIES AND MEETINGS

THE CRYSTALLOGRAPHIC SOCIETY

A STATED meeting of the Crystallographic Society was held on November 17, 1941, in Room 4-345, Massachusetts Institute of Technology, Cambridge, Mass. Twenty-six members were present. The proposed constitution and by-laws were discussed and approved, and the organization was placed on formal basis. The following officers were elected 1941–42: Professor Martin J. Buerger, *Presid* Professor Harry Berman, *Vice-President;* Dr. C ford Frondel, *Secretary-Treasurer.* At the close the business meeting, Mr. Joseph Lukesh spoke work carried on jointly by him and M. J. Buer

on "The Tridymite Problem." The talk was followed by a lively discussion bearing on the geological implications of the unusual thermal behavior reported, and on the mechanism of formation of super-structures based on silica frameworks. The speaker's abstract of his talk follows:

THE TRIDYMITE PROBLEM

Crystals of tridymite from Plumas County, California, have been investigated by the Weissenberg method. The diffraction symmetry of the low temperature form is *mmm*. It is based upon a face-centered orthorhombic lattice, the cell having the following dimensions:

$a_o = 9.91$Å $\quad b_o = 17.18$Å $\quad c_o = 81.57$Å

Possible space groups include *Fmm*, *Fmmm* and *F222*. The abnormal length of the *c* axis prompted investigation of tridymite from other localities. A sample from San Cristobal, Mexico, was found to have the same *a* and *b* axes, but the *c* axis was one half as long. The *c* axis rotation patterns of the two materials were substantially identical as regards distribution and relative intensities of all reflections except that the intermediate layer lines found on the pattern of the Plumas County material were missing on the pattern of the San Cristobal material.

Spectroscopic and chemical analyses of the Plumas County tridymite indicate a high impurity content, with an empirical formula approximating $NaCaAl_3Si_{15}O_{36}$. The presence of the impurity atoms is believed to be the cause of the doubled *c* axis.

Attempts were made using a controlled-temperature Weissenberg camera to locate the two inversions of tridymite at 117° C. and 163° C. as determined by Fenner from thermal observations on artificial material. The Plumas County material inverted directly from the low form to the high form at 127° C. with no evidence of a middle form. The tridymite from San Cristobal showed two inversions, low to middle at 121° C. and middle to high at 135° C. The absence of a middle form in the case of the Plumas County material and the smaller temperature range than expected in the case of the San Cristobal material are attributed to the presence of impurities.

Weissenberg patterns of the Plumas County tridymite were taken just above the inversion. In addition to the pattern to be expected from the hexagonal silica framework, there was found superimposed an orthorhombic pattern of satellite reflections which varied in their distribution in a definite manner with temperature, but not with time. The sequence was not reversible, and once it had been carried through to completion, it could not be obtained again on the same crystal. A similar, but less complicated, sequence was found using the material from San Cristobal. The presence and the behavior of the satellite reflections can be explained by the migration of the impurity atoms from positions taken at the time of formation of the crystals, when electrostatic forces only were satisfied, to positions taken during heating that are more compatible with packing requirements. It appears that both the Plumas County and the San Cristobal tridymite must have formed below 121° C. and 127° C., respectively, inasmuch as the temperature inversions are irreversible.

CLIFFORD FRONDEL,
Secretary

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE twenty-third annual meeting of the New Hampshire Academy of Science was held at the University of New Hampshire, Durham, on Friday and Saturday, November 14–15, 1941. At the Friday evening session, Professor Herbert E. Warfel of the university and the State Fish and Game Department presented the principal address, "Biological Basis for Fish Management in New Hampshire." Several reels of motion pictures of scientific interest were shown.

Saturday morning was given over to the reading of nine different papers by members, in the fields of geology, botany, ecology and anatomy. On Saturday afternoon, two papers were read in the field of meteorology.

At the annual business meeting, it was voted to award the grant-in-aid for the current year from the American Association for the Advancement of Science to Mr. Paul R. Doe, of Spaulding High School, Rochester, N. H., for a continuation of his work with time-lapse photography.

The following officers were elected for 1941–42: *President,* Dr. Charles D. Howard, State Board of Health, Concord; *Vice-president,* Professor Guy Williams, Colby Junior College; *Secretary-Treasurer,* Dr. Robert H. Denison, Wilson Museum, Dartmouth College; *Councilors,* Professor J. H. Gerould, Dartmouth College, for three years, and Professor Donald Chapman, University of New Hampshire, for four years; *representative* to the Academy Conference, W. W. Ballard, Dartmouth College.

The Executive Council voted to hold the next annual meeting at Keene, N. H., in the fall of 1942.

The address of the retiring president, Professor Bancroft H. Brown, of Dartmouth College, was on "Teaching and Research in a Democracy."

W. W. BALLARD,
Retiring Secretary

REPORTS

THE NEW ENGLAND FIELD GEOLOGISTS

THE thirty-seventh annual field meeting of the New England Field Geologists was held on October 10, 11 and 12, at Northampton, Mass. The headquarters for the meeting was in Seelye Hall, Smith College. Dr. Robert Balk, of Mount Holyoke College, was in charge

of the meeting, which was attended by 170 persons, representing 35 colleges.

Various sites of Triassic fossils were visited on Friday afternoon in the vicinity of South Hadley. Dinosaur footprints were viewed at two localities. Specimens of conifer remains were obtained in the Longmeadow sandstone. Miss Christine Lochman was the leader of this trip.

Dr. Balk led a party on Saturday which visited the fossil locality of Bernardston, Mass., from which the only identifiable fossil, according to G. A. Cooper, is *Spirifer divaricatus* of Onondaga age. The relations of the Bernardston formation to the older phyllites and slates were discussed, and the succession of rocks within the Bernardston formation was demonstrated. The rocks crop out mainly on the west side of the Connecticut River, but at a few places, typical phyllite and amphibolite appear east of the river. Outcrops of phyllite, one half mile from outcropping Pelham granitic gneiss (Carboniferous age) shows no effects of injection. A series of metamorphosed sediments east of the Pelham gneiss and outcrops of gneiss along the valley of Millers River were also visited.

R. H. Jahns and M. E. Willard, of the U. S. Geological Survey, conducted an all-day excursion on Saturday to examine sections of Quaternary deposits in the Connecticut Valley between Northampton and Turners Falls. The chief points of interest included outwash forms deposited in, and adjacent to, the great pre-glacial Connecticut valley lake, varved-clay bottom deposits and glacial spillways. The structure and morphology of the deltas and their relations to nearby ice-contact forms were demonstrated and their significance discussed. The relations, areal and vertical, of the glacial spillways to the adjacent outwash deposits were pointed out.

Three excursions were conducted on Sunday, October 12. M. E. Willard led one group in a study of the variations in rock types of the Triassic in the Connecticut Valley north of the Holyoke Range. The significance of these variations as they bear on the nature of the topography of the Triassic floor of deposition was discussed. Data obtained at exposures of a basal Triassic talus breccia together with information obtained from drill records indicate that the Triassic area of deposition is divided into two parts: namely, west of the present Connecticut River there was a deep north-south basin of deposition; and to the east there was a similar, but much shallower basin. It was suggested that the break between these two basins represented a now-buried fault scarp.

Miss Lochman led a group that studied two varved-clay localities. Special attention was directed to the problems of the Pleistocene *vs.* Recent slumping phenomena: the character and mode of formation of the zone of disturbed varves found at the top of ea section: the extent and significance of crumpled zon and the significance of different colorations of t clay layers.

A study of the geology of Winsor (Quabbin) da was conducted by a group led by Dr. Balk on Sund morning. The contact exposures of a series of chlor tic schists and an offshoot of the Belchertown tonali were studied in the spillway. The general geology the huge reservoir was described from the observati tower on top of Quabbin Hill. Exposures of met morphosed volcanics on the northeast slope of t hill and injection gneisses in the eastern portion the reservoir were also studied.

The 1942 field meeting of the group will be held eastern Massachusetts under the leadership of Robe Nichols, of Tufts College, and Dr. L. W. Currier, the U. S. Geological Survey.

LLOYD W. FISHER,
Permanent Secretary

LEWISTON, MAINE

SYMPOSIUM ON FOLSOM-YUMA PROBLEMS

AN informal symposium on the Folsom-Yuma a other problems related to Early Man in Nor America, especially in the Southwest, was held September 3 and 4, 1941, at the Laboratory of Anthr pology, Santa Fe, New Mexico. To this meetin sponsored jointly by the University Museum (Unive sity of Pennsylvania) and the Laboratory of Anthr pology, Santa Fe, were invited those interested in t various phases of this complex of problems. Happil many amateurs, or local archeologists, as well as t strictly professional men attended.

During the morning (E. B. Howard, *chairman*) a afternoon (F. H. H. Roberts, Jr., *chairman*) session on September 3, discussion was primarily directed t the problem of nomenclature of the Folsom, Yuma a similar points. It was proposed, after the discussio that a committee be chosen to prepare a resolutio embodying the conclusions of the informal discussio This committee, composed of Dr. E. B. Howard, D F. H. H. Roberts, Jr., and Marie Wormington, dre up resolutions, which were passed by unanimous vo at the morning session (Marie Wormington, *chai man*), on September 4.

These resolutions have been circulated among thos present at the meeting for further consideration an final approval and to those interested workers wh were unable to attend.

During the morning session, September 4, numerou problems were thrown open to general discussion Such matters as the possible spurious Folsom point reported especially from southeastern Colorado, an

the importance of detailed geologic interpretation and correlation of archeological sites were considered.

The success of the meeting as an open forum for the discussion of problems relating to Early Man has made all who attended hope for the establishment of an annual summer meeting, for which Santa Fe seems so admirably situated. Especial thanks for the success of this meeting are due Dr. E. B. Howard, of the University Museum, Philadelphia, Pa., who was responsible for the planning and organization, and to the staff of the Laboratory of Anthropology at Santa Fe, who acted as hosts.

LOUIS L. RAY

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SPECIAL ARTICLES

THE SUSCEPTIBILITY OF THE EASTERN COTTON RAT, SIGMODON HISPIDUS HISPIDUS, TO EUROPEAN TYPHUS

ONE of the outstanding difficulties in the study of typhus fever has been the lack of an animal in which the disease could be reproduced as it occurs in man. With this in mind, a search for more suitable experimental animals for the study of typhus was undertaken, and our results obtained with the eastern cotton rat, *Sigmodon hispidus hispidus,* are presented below. After these studies were under way, we discovered that Gerardo Varela[1] had already tested the susceptibility of these rodents to murine typhus. Although Varela was able to demonstrate the infectivity of the cotton rat brain as late as 5 days after inoculation, the rats themselves apparently remained healthy.

In our experiments the European typhus rickettsiae used were the well-known old Breinl strain and also three new strains isolated from patients in Madrid about 6 months ago during a recent epidemic of typhus.

Yolk sac membranes of developing chick embryos inoculated with typhus rickettsiae according to Cox's technique[2] served as the source of the infectious material for this study. In an experiment using cotton rats between 25 and 30 gm in weight, the smallest volume of a 10 per cent. yolk sac suspension given intraperitoneally which resulted in death was between 0.05 and 0.5 cc. By the intracardial and intranasal routes the minimal lethal dose was approximately 0.01 cc. At autopsy, rickettsiae were found in great abundance in the peritoneal exudate of the rats inoculated intraperitoneally; in the pericardial and mediastinal exudate of those injected intracardially; and in the lungs of those infected intranasally.

A striking relation between age of rats and their susceptibility to typhus was observed. In an experiment with eight cotton rats of different sizes given 0.1 cc of a 10 per cent. yolk sac suspension intracardially, those weighing 20 to 30 gm died in 3 or 4 days, whereas those weighing from 46 to 66 gm recovered from the infection after several days of experimental disease.

To determine whether the fatal infection in young rats could be prevented by a specific immune serum, samples of normal and convalescent human serum were mixed with equal volumes of a 20 per cent. infected yolk sac suspension. The mixtures were incubated for 1 hour at 38° C. and a group of the rats inoculated intracardially with each mixture. The convalescent serum used in this experiment had been obtained from patients 2 weeks after recovery from typical typhus. A portion of the 20 per cent. yolk sac suspension alone was similarly heated for 1 hour at 38° C., after which tenfold dilutions were made and groups of rats inoculated intracardially to serve as infectivity controls. The six rats receiving the convalescent serum survived, whereas the six which received normal serum succumbed 3 or 4 days after inoculation. The titration of the yolk suspension alone showed that the number of minimal lethal doses given each rat in this test with normal or convalescent serum was somewhere between 5 and 50.

In the cotton rats that succumbed to the intracardial injection of infected yolk sac the greatest number of rickettsiae was observed in the mediastinal exudate. The rickettsiae were also numerous in the liver. This organ was chosen as a source material for the serial passages of the infection in the rats. The Madrid-1 strain has now been carried through five passages. After four serial passages it produced fatal infection in all of three rats inoculated intracardially with 0.2 cc of a 10 per cent. liver suspension. The same volume of a 1 per cent. suspension likewise resulted in the death of all rats, whereas the animals given 0.1 per cent. suspension showed only slight evidence of experimental disease. By routes other than the intracardial a fatal infection in serial passage was not obtained.

Although it is obvious that a still more susceptible animal is needed, the results above indicate that the cotton rat is much more suitable than the guinea pig for the investigation of many problems in typhus fever which urgently await solution.

J. C. SNYDER

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LABORATORIES OF THE INTERNATIONAL HEALTH DIVISION,
THE ROCKEFELLER FOUNDATION

[1] Gerardo Varela, *Medicina* (Mexico), 13: 171, 1933.
[2] H. R. Cox, *Public Health Reports, U.S.P.H.S.,* 53: 2241, 1938; 55: 110, 1940.

THE NERVE-MODULUS FOR ANESTHETICS

FOR some years this laboratory has examined the quantitative effects of local anesthetics upon nerve action-potentials. Full details of apparatus and methods will be published elsewhere. It was found that for sciatic nerve of *R. Pipiens*

$$T \log R = Z$$

when:

T is the elapsed time in minutes between the application of the anesthetic and a decrease in action potential of 80 per cent.

R is the ratio $\frac{\text{molarity—minimum effective molarity}}{\text{minimum effective molarity}}$

Z is a constant.

We propose to call the quantity Z the nerve-modulus for local anesthetics. It was found closely to approximate 5.50 for five local anesthetics of unrelated chemical structures.

In the determination of local anesthetic-potency it is a common practice to use the minimal effective concentration (Mm) as a criterion of potency. Mm is frequently determined by successively testing solutions of decreasing concentrations. Because the relationship between block-time and molarity is hyperbolic the experimental determination of the minimum effective concentration presents practical difficulties. The use of the modulus Z renders this procedure unnecessary as from it the minimum effective concentration can be readily calculated.

Thus

$$\text{Log } R = \frac{Z}{T}$$

$$R = \log^{-1} \frac{Z}{T}$$

and

$$R = \frac{M_1 - Mm}{Mm}$$

$$Mm = \frac{M_1}{1 + \log^{-1} \frac{Z}{T}}$$

or more conveniently (and because $Z = 5.50$)

$$Mm = \frac{M_1}{1 + \text{antilog} \left(\frac{5.50}{T}\right)}$$

Thus in comparing an anesthetic with procain the ratio:

$$\frac{M_1 \left(1 + \log^{-1} \frac{Z}{T_2}\right)}{M_2 \left(1 + \log^{-1} \frac{Z}{T_1}\right)} = P$$

When:

M_1 = molarity of procain
M_2 = molarity of anesthetic tested
T_1 = block-time for procain
T_2 = block-time for anesthetic tested
Z = modulus or 5.5
P = potency (relative to procain)

Consequently the minimum effective concentration of procain and the unknown may be compared without the determination of the Mm of either. When anesthetics differing widely in potency are compared it is not usually possible to use equimolar concentrations in testing them, because an effective concentration of one will be either too concentrated or too dilute for the other.

The modulus permits direct comparison of solutions of unlike molarities. To correct the block-time for differences in nerve-diameters the standard nerve diameter was arbitrarily taken as 500 micra. The block-time for a given molarity was found to vary as the square of the diameter of the nerve. Therefore it is a simple matter to correct an observed block-time to that for a standard nerve of 500 μ. In practice a concentration of anesthetic is selected that causes 80 per cent. block in from 3.5 to 12 minutes. Higher concentrations give inaccurate results because when excess anesthetic is present the molar/time relationship is not valid. Lower concentrations yielding long block-times are inconvenient for the same reason that renders the determination of Mm difficult. When a number of determinations of T have been made for one or more values of M the times are corrected to standard diameter, averaged, and Mm calculated. The validity of Mm can then be checked by direct experiment. When this is done, 45 minutes is arbitrarily taken as the time in which a decrease in the action potential must be observed in order for the concentration to be considered minimal. In the five anesthetics tested Mm calculated from Z closely corresponded with the experimentally determined values.

For anesthetics having prolonged action such as Nupercain the calculated Mm was found to exceed the determined Mm. These anesthetics block nerve-conduction for much longer periods than those for which the modulus was found to hold, recovery-time in some instances being as long as 3 or 4 hours contrasted with 30 minutes or less for anesthetics such as cocain and procain. The modulus proves useful in making rapid preliminary tests of new compounds. When it is found that the recovery time after 80 per cent. block is longer than 30 minutes, the calculated Mm should be checked by direct experiment before attempting to use the modulus to calculate the relative potency P. Further experiments are in progress.

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THE QUANTITATIVE RELATIONSHIP OF RIBOFLAVIN TO CATARACT FORMATION IN RATS

NUTRITIONAL cataract in rats due to avitaminosis was first described by Day, Langston and O'Brien.[1]

[1] P. L. Day, W. C. Langston and C. S. O'Brien, *Amer. Jour. Ophth.*, 14: 1005, 1931.

Later Bessey and Wolbach[2] described other ocular changes due to Vitamin G deficiency but reported that cataract occurred in only a small percentage of their animals. El Sadr[3] observed both the corneal opacity, vascularization and cataract reported by the above workers. Day, Darby and Langston[4] subsequently identified riboflavin as the cataract preventive factor.

Since these workers had used different rations and since their results were varied, a series of experiments was undertaken to explain the inconsistency of cataract formation in rats fed on riboflavin deficient diets.

Sixty rats were placed on the diet of Bourquin and Sherman.[5] A microbiological assay by the method of Snell and Strong[6] showed this ration to contain riboflavin in such amounts that our animals received 0.57 micrograms per day on the basis of average food consumption. Another group of fifty animals was placed on a modified ration of Bourquin and Sherman in which the B-complex was supplied by adding sufficient amounts of crystalline thiamin, pyridoxin, nicotinic acid, pantothenic acid and choline, instead of the 80 per cent. alcoholic extract of wheat. Some of these animals were supplemented with varied amounts of riboflavin while others received only the basal ration.

A third group of twenty animals was placed on a riboflavin free diet in which 14 per cent. Crisco was used as a source of fat instead of the 8 per cent. filtered butter fat used in the Bourquin-Sherman diet. The animals on this ration were supplemented with 50 gamma thiamin, 20 gamma pyridoxin, 200 gamma nicotinic acid, 100 gamma pantothenic acid and 5 milligrams choline per rat per day.

The results of these experiments variously corroborate all the work done on riboflavin deficiency as it affects the eyes of rats. Corneal opacity and vascularization occurred in all animals except those receiving adequate amounts of riboflavin. Cataract occurred in 90 per cent. of the animals on the Bourquin-Sherman diet within 9 weeks.

On the modified ration, 85 per cent. of the animals receiving between 1 and 3 micrograms of riboflavin daily developed cataract in 10 weeks. On the modified ration without the riboflavin, only 14 per cent. of the animals exhibited cataract formation. The time periods in each case were comparable, *i.e.*, cataract had developed in the animals receiving small amounts of riboflavin at a period when the negative controls were alive and exhibiting some growth but without the development of cataract.

All the animals on the third ration failed to develop cataract within twelve weeks after which they were discarded.

These results indicate that rats on a ration devoid of riboflavin do not exhibit cataract. Minute amounts of riboflavin induce cataract formation and rations containing more nearly adequate amounts are noncataractogenic. This would explain the inconsistency reported by various workers of cataract production on rations which were deficient but not entirely riboflavin free. Our results are also in agreement with the observations of Stokstad and Manning[7] on the incidence of the curled toe paralysis syndrome in chicks. These findings demonstrated a lack of curled toe paralysis except when small amounts of riboflavin were present. A more complete report of these findings will appear elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TEST-TUBE SPIRAL ABSORPTION VESSEL

A SIMPLE, efficient and inexpensive vessel for carbon dioxide absorption has been constructed and extensively used for plant respiration measurements. As seen in Fig. 1, this absorption cell has the added advantage of compactness. This feature is obtained by the use of a test-tube for the shell of the apparatus.

The nucleus around which the absorption cell is built consists of a glass spiral through which a chain of gas bubbles moves in contact with the absorbing solution. This spiral tube lengthens the path of the bubbles and thus prolongs the time of contact between the gas and the solution. By this means, increased efficiency of absorption is obtained. Apparatus built upon this principle have been described, heretofore, by Harvey and Regeimbal,[1] and also by many other designers of similar apparatus.

As indicated in Fig. 1, the apparatus includes a test-tube (b) fitted with a two-hole rubber stopper (a) through which pass a long inlet tube and a short outlet tube. The inlet tube is bent just below the rubber stopper so that its longer portion is centered in the

[2] O. A. Bessey and S. B. Wolbach, *Jour. Exp. Med.*, 69: 1, 1939.

[3] M. M. El Sadr, *Chem. and Ind.*, 58: 1020, 1939.

[4] P. L. Day, W. J. Darby and W. C. Langston, *Jour. Nutrition*, 13: 389, 1937.

[5] A. Bourquin and H. C. Sherman, *Jour. Amer. Chem. Soc.*, 53: 3501, 1931.

[6] E. E. Snell and F. M. Strong, *Ind. and Eng. Chem.* (Anal. Ed.), 11: 346, 1939.

[7] E. L. R. Stokstad and P. D. Manning, *Jour. Nutrition*, 16: 279, 1938.

[1] R. B. Harvey and L. O. Regeimbal, *Plant Physiol.*, 1: 205–206, 1926.

test-tube. The lower end of the inlet tube is drawn out to form a short nozzle (d), which is bent sharply upward. A spiral of glass tubing (c), open at both ends, fits loosely over the upturned nozzle. As the carbon-dioxide laden air stream passes through the nozzle and enters the spiral in the form of bubbles, some of the absorbing liquid also enters the spiral. This results in a continuous circulation of liquid, both through the spiral tube in which the absorption takes place and in the test-tube itself.

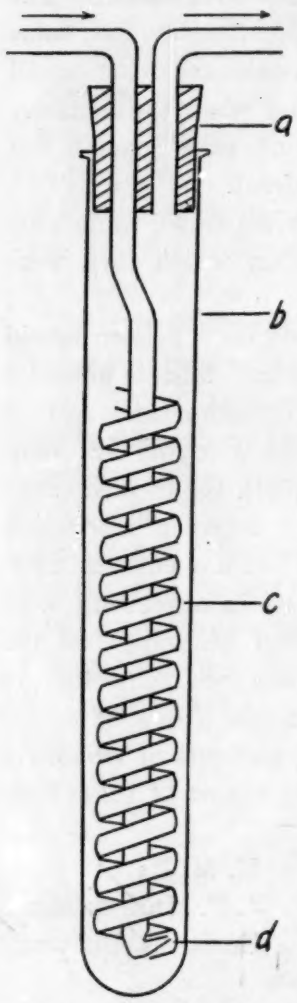

FIG. 1. Details of absorption vessel: (a) two-hole rubber stopper; (b) test-tube; (c) glass spiral; (d) nozzle at end of inlet tube.

The spiral may be formed of glass tubing softened in the flame of a blast lamp and turned around a piece of brass tubing of the proper size. A slight taper on the brass tube makes for ease in the removal of the glass spiral after turning.

Two sizes of these absorption vessels have been constructed and used in respiration studies. The smaller one holds 25 ml of solution and consists of a 22×175 mm test-tube with spiral and inlet tube made of 6 mm tubing. The spiral is 18 mm in diameter and 105 mm in length. The larger vessel utilizes a 25×200 mm test-tube with proportionately larger spiral and inlet tube. This absorption vessel holds 50 ml of solution. In all cases, the volume of the absorbing solution should be sufficient to cover the top of the spiral but should not be so great as to cause liquid to be forced up into the outlet tube when in operation.

Potassium and sodium hydroxide solutions of 0.10 and 0.05 normality have been successfully used as carbon-dioxide absorbents with this apparatus. Solutions of barium hydroxide are not recommended because of a tendency to block the inlet nozzle with precipitated carbonate. At the end of a run, the absorption vessel is disconnected and tilted so as to drain out the alkali solution through the outlet tube into a small flask. This flask should then be stoppered to protect the solution from atmospheric carbon dioxide. Aliquots may be pipetted from this solution and titrated in the presence of excess barium chloride against phenolphthalein with dilute standard hydrochloric acid (0.10 or 0.05 N). The addition of barium chloride in excess results in the precipitation of the absorbed carbon dioxide as barium carbonate previous to the titration. Acid titration values thus obtained give a measure of the unused hydroxide and, in comparison with corresponding values obtained with the original solution, give an accurate index of the carbon dioxide absorption.

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A SIMPLE METHOD OF REMOVING SCALES FROM LARGE LEPIDOPTERA

CONSIDERABLE difficulty is usually experienced in removing scales from the bodies of large thickly clothed Heterocera in preparation for morphological study. The following method has been used successfully by the writer with specimens of the tobacco hornworm (*Protoparce sexta* (Johan.)). This method can be used effectively with either fresh or dried specimens, although fresh specimens are denuded more easily. The wings are removed and the scales are dislodged from the body by brushing with a small toothbrush. A child's brush with moderately stiff bristles, all of approximately equal length, will be found best for this purpose. Stroking is most effective over the soft chitin of the abdomen, while a reciprocating motion produces better results on the head and thorax.

Fine scales on the legs and wings can not be removed readily by brushing. These parts may be cleaned easily by placing them in a 5.25 per cent. solution of sodium hypochlorite for a short period. They should be removed and rinsed in distilled water not over two hours after immersion in this solution.

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BOOKS RECEIVED

STEINBECK, JOHN and E. F. SHERWOOD. *Sea of Cortez.* Illustrated. Pp. 596. The Viking Press. $5.00.

WARNER, W. LLOYD and PAUL S. LUNT. *The Social Life of a Modern Community.* Pp. xii + 460. Yale University Press. $4.00.

STRATTON, J. A., P. M. MORSE, L. J. CHU and R. A. HUNTER. *Elliptic Cylinder and Spheroidal Wave Functions.* Massachusetts Institute of Technology Publication. Pp. xii + 127. John Wiley. $1.00.

The Foundations of Conservation Education. Pamphlet No. 3, Education in Conservation. HENRY B. WARD, editor. Illustrated. Pp. vi + 242. National Wildlife Federation.

Comparative Biochemistry. Intermediate Metabolism of Fats. Carbohydrate Metabolism. Biochemistry of Choline. HOWARD B. LEWIS, editor. Volume V of Biological Symposia, JAQUES CATTELL, editor. Pp. ix + 247. Jaques Cattell Press. $3.00.

Carnegie Institution of Washington, Year Book No. 40. July 1, 1940 to June 30, 1941. Pp. xxxii + 336. Carnegie Institution of Washington.

SCIENCE NEWS

Science Service, Washington, D. C.

THE RELATIVISTIC UNIVERSE

PROFESSOR ALBERT EINSTEIN drove the final scientific rivet in the relativistic universe which he began to build more than two decades ago to replace the edifice erected by Newton. In a report presented at the Princeton meeting of the American Physical Society he announced the final development of his gravitational theory at the Institute for Advanced Study, where he almost lives and does his work.

Previously, Einstein had been able to prove his gravitational theory only for certain special cases. Now the structure is completed by a perfectly general and rigorous mathematical proof that it applies in all cases.

In his paper, it is rigorously proved, from the equations of the theory of general relativity, that there do not exist any gravitational fields of finite total mass which are free from singularities (*i.e.*, which are finite at every point). Until now this was proved only for fields with certain symmetry properties.

Scientists have ceased to discuss whether relativity is true or not. It is accepted and applied in all branches of physical science. Especially in atomic physics, its triumphs have been great. The conversion of mass into energy accounts for the heat of the sun and the long life of the stars. The hope of atomic power rests on the same basis. These are but two of its accomplishments.

Albert Einstein, now sixty-two years of age, proud of his American citizenship, is the world's most distinguished refugee from Nazi Germany. He was in New York early in 1933, on his way back to Germany after a visit to California, when Hitler swept into power. Since then he has remained, and we hope will long remain, our Einstein.—MORTON MOTT-SMITH.

THE KODACOLOR FILM

SPEAKING at the Franklin Institute, Philadelphia, Dr. C. E. K. Mees, research director of the Eastman Kodak Company, described a new Kodacolor roll-film produced by the company.

Home picture takers are already familiar with color pictures. But for the most part they have had to be content with color movies or transparencies which can be shown only when projected onto a screen. Color prints could be made from these only at considerable expense and some uncertainty of the outcome. The film would fit only some cameras, usually expensive ones.

Now even the small boy or girl with a box camera can snap pictures with the new Kodacolor film, which will be available in six standard sizes. The film must be returned to the manufacturer for processing. When it comes back to the photographer, he will have a set of color negatives —not color transparencies as in the Kodachrome now available for 35 mm. cameras. Light areas of the subject will appear dark in these negatives, and dark areas, light. The colors also will be in reverse—that is, they will be complementary to those in the actual subject. With these color negatives, the photographer receives full color prints on paper.

The new Kodacolor film, like its predecessor the Kodachrome, is a sort of photographic layer-cake of color-sensitive emulsion layers. In the Kodacolor process, however, the "couplers" in which the color image is formed are not dissolved in the emulsion layers themselves, but in particles of organic materials of microscopic size which protect them from the gelatin and, at the same time, protect the silver bromide from any interaction with the couplers. When the film is placed in the developer, the oxidized developer penetrates the particles and there reacts with the coupler to form the dye. There are three of the emulsion layers and also a yellow filter layer on the film. The developer in which it is processed acts simultaneously on all three couplers, producing a dye image in each layer. When the finished negative is printed on a paper coated with a similar set of emulsions, the resulting color print has the colors of the original subject.

SULFANILAMIDE

How sulfa drugs can overcome one of the worst horrors of war casualties, germ infections in wounds, was described in reports at the Baltimore meeting of the Society of American Bacteriologists.

Sulfanilamide itself is the best of the sulfa drugs for this purpose, in the opinion of Dr. Roy G. Klepser and Dr. J. Ross Veal, of Gallinger Municipal Hospital, Washington, D. C. They reported on their use of sulfanilamide in treating more than 500 infected wounds. Other sulfa drugs are more effective in test-tube experiments, but have no advantage in actual wound treatment and are as much as eight times as expensive.

After three or four days, sulfanilamide powder checks the healing of wounds, probably because of its drying effect and the substitution on the third or fourth day of treatment is advised of an ointment containing a lower concentration of sulfanilamide and also containing allantoin. This chemical is the substance from fly maggots which the late Dr. William S. Baer, of Baltimore, found to be good treatment for infected wounds.

Wounds can be about two thirds sterilized within three or four days, Dr. Klepser said, provided the wound is draining adequately and the sulfanilamide is in contact with the germs. Dead tissue must be cleaned away or it will interfere with the action of the drug. The sulfanilamide does not kill the germs in the wound directly, but starves them out by combining with their food supply.

Sulfanilamide is effective against all kinds of germs which get into wounds and burns. It must be put directly on the wound in order to get a high enough concentration. When the drug is given by mouth the dosage is calculated generally to give a concentration in the blood of about eight milligrams per 100 cubic centimeters, but by putting the drug directly on the wound, a concentration 100 times as high can be reached in the fluid in the wound tissues.—JANE STAFFORD.

GERM CHEMICALS FROM THE SOIL

FROM germs living in the earth itself and from common molds like those that spoil bread, nearly a dozen new weapons for fighting disease have been obtained. Some of these new chemicals are powerful enough to rival the sulfa drugs in stopping germ invasion of the human body, according to reports presented before the Society of American Bacteriologists.

Dr. Selman A. Waksman and Dr. H. Boyd Woodruff, of the New Jersey Agricultural Experiment Station, stated that some of these germ chemicals can kill other germs outright. Others, unable to kill germs, can nevertheless stop their growth. Gramicidin, already being used in treating patients, is most specific, acting primarily on tiny round germs labelled gram-positive micrococci. Penicillin, another of these germ chemicals which has already reached the stage of practical use, and two other substances from different microorganisms, pyocyanase and pycanin, are similar in their action over the whole range of germs in the tests. Some germs are killed by penicillin and some only stopped by it, according to Dr. Gladys L. Hobby, Dr. Karl Meyer, Dr. Martin H. Dawson and Dr. Eleanor Chaffee, of Columbia University.

In tests at the Mayo Clinic, reported by Dr. Dorothy Heilman and Dr. Wallace E. Herrell, gramicidin was more effective than penicillin against one kind of streptococcus and a pneumonia germ, but penicillin was more effective against another streptococcus and a staphylococcus organism.

From these and other studies will come knowledge needed for using effectively these new chemical weapons against disease.—JANE STAFFORD.

RUSSIA'S GRAIN VARIETIES

THE United States Government has offered to aid in rescuing from destruction Russia's important grain varieties, to keep them alive for the time when scorched earth can spring up green again.

Responding to a suggestion by Sir John Russell, of the Rothamsted Experimental Station in England, who feels that the need is urgent, the U. S. Department of Agriculture stands ready to receive and plant special Russian grains in United States areas suited to them, or to aid in any other way practicable.

British scientists are expected to salvage Russia's important fruit tree varieties. Very little material is needed and it can be carried by air. British varieties of fruits would not be at all suitable, he emphasizes.

To lessen hunger and suffering, agricultural reconstruction will be tremendously important in fought-over areas, deliberately burned by Russian peasants to prevent enemy use. Russian plant breeders have successfully produced many varieties of crops suited to specific regions, particularly drought-resistant varieties. Years of labor would be lost if seed for future planting is not saved from the chaos of war.

ITEMS

PROTECTION against some of the ailments called 'flu, grippe or colds, may be achieved through development of a discovery announced by Dr. Rene J. Dubos, of the Hospital of the Rockefeller Institute for Medical Research. A toxin or poison from the influenza bacillus has been obtained by Dr. Dubos in the form of a dry powder. A tiny speck (one tenth of a milligram) of this powder when injected into rabbits kills them within a few hours. But this lethal stuff can be used to protect rabbits against both the poison and the living germs which produce it. The blood of immunized rabbits will in turn protect other rabbits from either the poison itself or the living germs.

THE germs which are believed to cause trench mouth, so-named because it was a serious ailment of soldiers in World War I trenches, have now been examined under the electron microscope, which uses particles of negative electricity to peer into secret places of matter that can not be seen with microscopes using light and optical lenses. Pictures of these and of the syphilis germ and other germs were shown at the meeting of the Society of American Bacteriologists by Dr. Katherine A. Polevitzky, Dr. Thomas F. Anderson and Dr. Harry E. Morton, of the University of Pennsylvania and RCA Manufacturing Company. Tiny hairs, heretofore seen only with difficulty, were clearly visible at the ends of thin, spiral germs from human mouths. The syphilis germ was found to be frequently surrounded by a slime sheath which occasionally formed thin tendrils projecting from the organism.

THE old fable that dogs pant because they can not sweat has been "shattered" by discovery of sweat glands in their skins, according to the editor of the *Lancet*. J. G. Speed, of Edinburgh, has found sweat glands in the skin of the lips, head, back, thorax, shoulders, thighs and pads of the feet, a finding previously reported by numerous other investigators but apparently not generally known. Nevertheless, the dog does pant, and it would be interesting to know how effective the skin sweating is and whether all breeds of dogs are equipped with sweat glands in their skin. Absence of visible moisture on the skin may be due to efficient evaporation while the probability of water vapor enmeshed in the hairs suggests the reverse.

SULFATHIAZOLE, one of the sulfa drugs, appears to be the means of an effective, broad-scale attack on gonorrhea, according to a study by Drs. J. F. Mahoney, C. J. Van Slyke and R. R. Wolcott, of the U. S. Public Health Service, according to a report on the results of sulfathiazole treatment of 360 patients at U. S. Marine Hospital, Staten Island, N. Y. The gross rate of cure for the 360 patients was 85.4 per cent. None of the patients was severely poisoned by the drug, and even mild symptoms were infrequent.

DAMAGE to body organs due to heavy insulin dosage required in shock treatment for the mental disease, dementia praecox, may be avoided by lesser insulin doses, it appears from studies reported by Dr. Frank N. Low and Dr. H. Ward Ferrill, of the University of North Carolina, in the current issue of *Endocrinology*. Five successive generations of white rats were given insulin doses just under amounts necessary to cause shock. Examination of the rats after death and study of their organs under the microscope showed no damage directly traceable to the insulin. Some psychiatrists believe that results in dementia praecox treatments with insulin are just as effective if shock is not produced.